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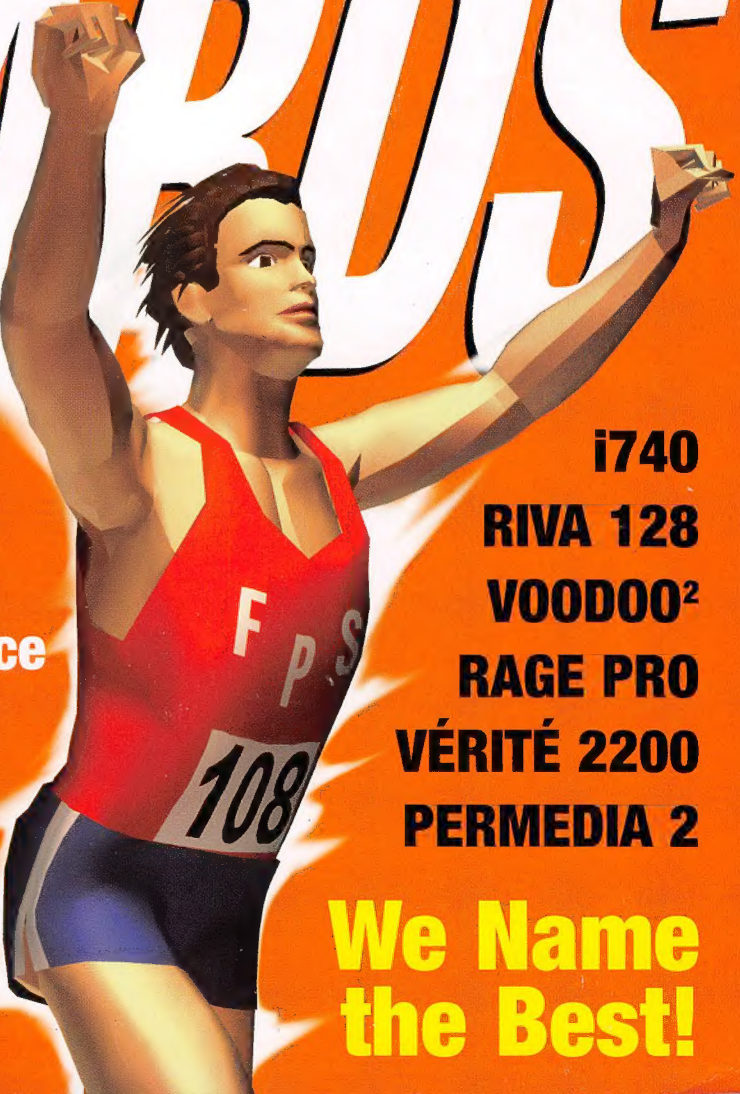

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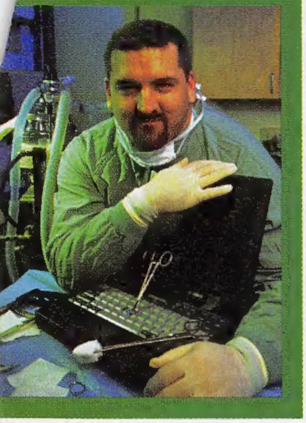

Face Time

When you turn the page, look next to the ever-popular Comm Port at our staff box (that's the tiny text where the perpetrators of this magazine line up to be identified). Along with the usual suspects, a couple of new faces are joining the most-wanted list this month.

These latest additions only serve to make *boot* the best Pure PC Power publication on the face of God's green.

First there's Ravishing Rick Popko. Rick joins the *boot* posse fresh off doing time at the digital-video mag appropriately named *DV*. While there, Rick served as technical editor. He promises to share all his inside knowledge of this red-hot technology with all you bootists, while pursuing the latest and greatest in this emerging field.

> Along with the **usual suspects**, a couple of new faces are joining the **most-wanted list** this month.

As software editor, Rick will keep everyone up on the fuel our PCs crave each and every.

Next on board is Gordon "Gung" Ung, recently sprung from the industry's oldest news weekly, *ComputerWorld*. His beat there was PC software, and he broke a few skulls. Before *CW*, Gung was lead reporter on the police beat at a Bay Area daily newspaper where he honed the skills he'll apply as our new online editor in charge of getting red-hot content up on the bootnet daily and making sure you don't use dirty words in the online Comm Port replies. (You know which words we mean!)

Last is the big guy buried in the bottom, our new publisher Gene Burns. We call him Mister; he calls us Smithers. Gene'll lead the charge to make *boot* a fatter book to accommodate all the phat news and reviews, tools and techniques, speeds and feeds that we want to get out.

The truth is out there, and with the help of diehards such as these, we promise to get it to ya!

Brad Dosland
Editor in Chief

Creative Labs Voodoo^2, p.72

NEWS

14 bootWire News that **matters.** The long-awaited **V.90 modem spec** has been finalized… Seagate's hard drive breakthrough promises **40GB capacities**… Intel details its new **low-cost cacheless P-II** and mobile Deschutes. PLUS the debut of the pulse of the PC fanatic: **The boot Opinion Poll**

VOICES

14 Comm Port The smartest **readers** in the world **speak out.**

21 The Saint **Alex St. John** saw everything while **inside the empire's walls** and explains how one little man runs the show.

23 Game Theory **T. Liam McDonald** completes his explanation of why bad games survive with some examples of the **best and the worst.**

25 On the Line **Shel Kimen** went to great lengths to find a developer willing to admit that he **uses Java and is damn proud of it.**

27 Fast Forward **Tom Halfhill** knows you will read his column this month because he employs the same **branch prediction algorithms** that the IA-64 does.

96 Glitch **Jon Phillips** had a childhood filled with G.I. Joes and Rockem-Sockem Robots, but what he really wanted was an **EZ-Fab Oven.**

THE TECH FILES

52 12-Step/Clinic Get familiar with the tool-packed art program **Satori** on this month's bootDisc, and follow along as we make some shocking 2D graphics.

P/REVIEWS & PRODUCTS

18 Pure Lust **Tech toys** for digital girls and boys.

66 Previews This month boot scores another hands-on exclusive. Early silicon of **Matrox's Voodoo^2 Killer**—the MGA-200—runs the bootMark gauntlet. ALSO The jack-of-many-trades **Mpact2 3DVD** processor in a hands-on test of its mettle, and **Jane's F-15** looks simply fabu.

70 Reviews More of the sexy tech you love to lust after:
- The first batch of **32x CD-ROM drives** try to deliver on their promises.
- Face facts: You need **anti-virus software** to protect yourself. We test the best.
- Venerable PC retailer CompUSA steps up with its first self-named system.

Axis NeyEye 200, p.85

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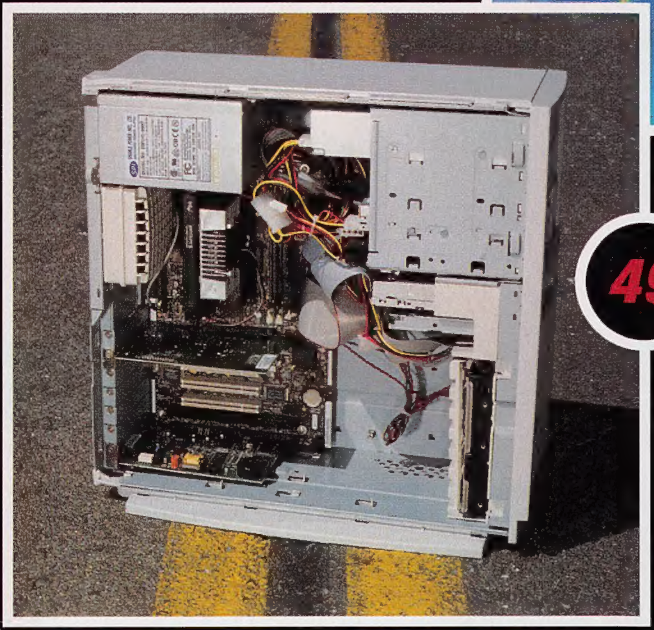
Lip *Intel's Platform Architecture Manager* ***Jay Sturges*** *and* ***Brian Ekiss****, Graphics Marketing Manager, get deep into the facts about the* ***big fish*** *entering the small pond of 3D cards.*



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400MHz Muscle Machines

The ***fastest*** *systems ever to roll off a PC production line go* ***head-to-head-to-head*** *in a three-way drag race. The* ***screaming lap times*** *will leave you silly.*

3D Card Triathlon

38

Six chipsets compete in the ***ultimate contest*** *of 3D rendering speed, visual quality, and features. This is it, sports fans, we choose* ***the best gaming card ever****.*

Cover *Illustration by Mitchell Hudson*

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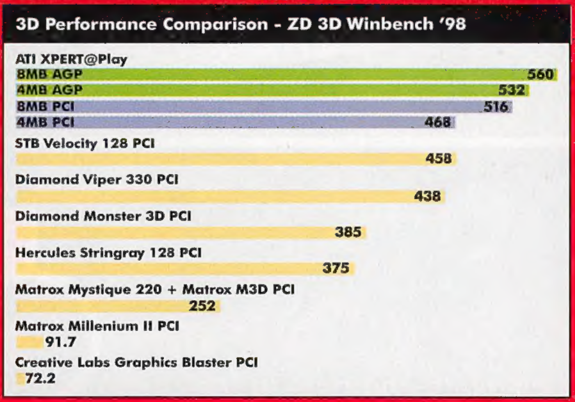

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COMM PORT

The More The Merrier

I was reading that Lip interview you guys had with that Mr. Chips guy (*boot* 19), and I got to thinking. If this guy is selling Pentium-class CPUs for under $50, why not just build a huge, fucked-up motherboard with a whole load of Socket 7 sockets and go to multiprocessor heaven? It'd be useless if all you do is play games all day, but people who use real apps (*3DSMax* and *Photoshop* come to mind), would find 16 or so processors to be flenchy as hell.

In fact, why have only one processor in any computer? Having one overpriced Pentium II in a computer is kinda like having a Ferrari with a gigantic, one-cylinder, two stroke engine in the back. A shift to a multiprocessor architecture would make computers cheaper, faster, and a lot more scalable. You'd have to redesign a lot of stuff, like cases (to accommodate huge motherboards) and operating systems. The only software you'd really have to rewrite would be games, since other classes of software either support multiprocessing or don't need the speed.

I just had an even better idea! Build the motherboard with the huge number of chip sockets, except have it so each chip doesn't need to be the same as the others. If you set it up right, you could have specialized chips for different functions. A chip for fast-ass floating-point ops. Another one for 3D acceleration. Hell, all you game pups can throw in a bunch of those and play *Quake III* at 1,000fps! Intel comin' out with MMX 4? Forget an expensive chip replacement, just buy an MMX4 chip. Or buy two for twice the pointlessness!

In my current deranged state, this looks to be the future of computing.

Sam Cooper

"Having one **overpriced Pentium II** in a computer is kinda like having a Ferrari with a gigantic, one-cylinder, two stroke engine in the back."

Sporting A Woody

I'm sorry, but the wood-encased computer by WoodTech PC (*boot* 19) is ugly! What's next, a FlintstonesTech rock-encased PC?

Marisa

When Games Attack

I must applaud T. Liam McDonald for stating what has been running through the minds of gamers of late. His last few columns put into print and in no uncertain terms the problems the game industry has begun to inflict on the consumer to further their own bottom lines.

McDonald is highlighting practices that are morally wrong, but has thus far failed to address one topic I feel is of monumental importance to the well being of the game industry. Far too often these days we're seeing games with immense budgets and even larger advertising budgets. The games boast innovative new features and unprecedented graphical accomplishments.

But they aren't fun.

Games, by definition, are entertainment software. Each game that isn't entertaining is a black mark on the game industry. Packing in 3D graphics acceleration and stereophonic sound won't help a bad idea. Neither will multiplayer support. And somebody please tell these people that a bad game does not need a plug-in pack to remedy any of the issues, because it won't help!

A few good companies remain, but all too often it's profit margins and not consumers that companies survey for new ideas.

Joshua Crow

Good With The Bad

I agree with most of McDonald's piece in Game Theory *(boot* 19). I've worked in the game industry at Jane's Combat Sims/Origin and can identify why a lot of the "features" get left out of the products, and I know how bugs get left in.

Luckily, I worked with a first-rate group of people who cared about every facet of our products (*ATF/NATO Fighters*). But it's disconcerting to see some of the material for sale today. Anyone who bought *Red Baron 2* or *Pro Pilot* can identify with that.

Personally, I think the problem is that developers are no longer in control. Marketing/Biz is running the show, even to the point of the specified system requirements printed on the box.

I was miffed at *Jet Fighter III*'s lack of multiplayer after it was promised, but I have to commend Mission Studios. Those guys did something unprecedented in the gaming industry. They provided a 3Dfx patch free and completely unsolicited to those who had purchased the title. This wasn't something they had to do, but it was a wonderful gesture, considering the way other companies support products. I just thought with all the bad practices going on in the gaming industry, the good ones (few and far between) should be presented!

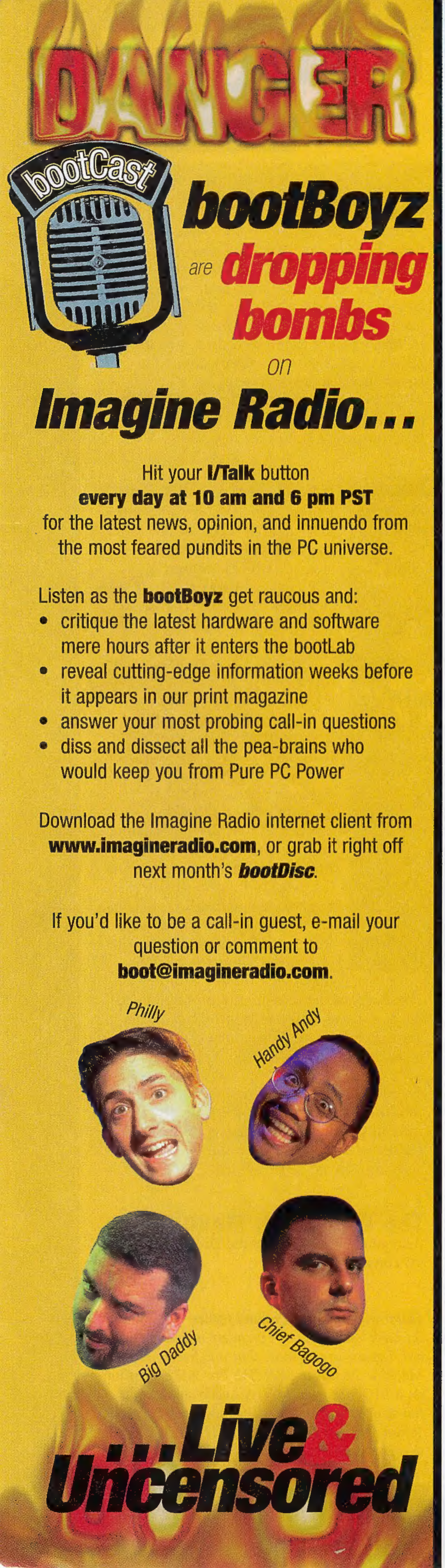
Bob Lionel

The Way-Back Machine

Just out of curiosity, what did Dream Machine 96 consist of?

Chris Kashuba

Editor in chief Brad Dosland replies: *Well, since the back issues of* boot*'s premiere issue are sold out, I guess we can share that info freely. Dream Machine 96 was a 200MHz Pre-MMX Pentium on a FIC mobo with a VIA Apollo chipset in a full-size tower case with a 300-watt power supply. It had 32MB of DRAM and a 512K cache. Video was pumped through Matrox's 4MB Millennium*



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COMM PORT

to a 17-inch Nanao monitor. Quantum's 2.1GB Atlas hard drive rode on the SCSI bus provided by an Adaptec Ultra Wide SCSI 3 controller. And a 4x CD-ROM drive with a burly 28.8 modem rounding out the chronologically challenged system. In our youthful naivete, we didn't spec out a soundcard, speaker system, mouse, or game controller.

Of course, keep in mind that our top coverline on that issue boasted about "First Look: 200MHz Monster Systems with onboard 3D"!

Cool World

Reading about your Dream Machine 97, I built a P-II 300 with the smokin' Asus P2L97-S board and the Cheetah UW 4.3GB speedy gonzalez. I used the same case as you, but the damn thing makes so much heat I had to make my own vents with a drill!

I bought three 12v chassis fans, inverted the drive on the bottom 3.5-inch bay, and secured one of the fans to the middle 3.5-inch bay blowing air on the drive's controller board. The second fan is screwed to the inside of the case on the left side, blowing cool air from outside across the bottom of the drive, and I placed the third fan next to the power supply on the top of the case sucking hot air out. This reduced the overall temp about 15 to 20 degrees, and kept my system from locking up all the time.

Roger Somazzi

P-II Lock Down

Is the "locked multiplier" situation with new Pentium II CPUs real or not?

Wes

Senior editor Andrew Sanchez replies: *Yes, it is for real. With recent CPUs, Intel has tweaked the innards and locked out higher multipliers. The only real way to test is to try overclocking your system by bumping up the speed one bin—if it refuses to boot, you're out of luck. You may be able to bypass it by overclocking via a different system-bus speed, but your resulting system stability will vary depending on your current equipment.*

Rhapsody On Blue

I've heard a few game developers comment on what a great OS Rhapsody is. One went so far as to say his company would dump NT if Apple would support OpenGL, which of course, it won't. Now with Apple seemingly gearing Rhapsody as a server solution, it appears we'll be stuck with the Windows platform. We won't have a *real* choice. (Linux is great, but it's too hard to set up for most end users' tastes).

Microsoft seems determined to ram Windows down our throats, regardless of its deficiencies, and Apple, which has an alternative, is too blind or stupid to maximize Rhapsody's potential on the x86. What do you think are Rhapsody's chances on the PC?

Patrick Conlon

Software editor Rick Popko replies: *There's a lot of buzz going about how Rhapsody is going to completely change the PC. But let's not confuse hype with reality.*

First, how many people have actually seen Rhapsody running on a PC? Second, Rhapsody is based on the NeXT OS (we all know how that changed the world). Third, as far as Rhapsody's dominating the PC platform, I don't think we have to look any further than OS/2 (wasn't that supposed to kill Windows 95?).

And let's not forget that BeOS release 3 is out now. Do you think it stands a chance out there? Truth be told, it will take more than an 800-pound gorilla to take Microsoft down (hell, even SGI has conceded to start cranking out NT boxes). Those are the facts, jack.

Mix And Match

We've all heard how great Voodoo^2 is, but nearly all the benchmarks I've seen have been conducted with Pentium II 300's. How will all these new videocards perform with other processors? Specifically the AMD K6-233 and the Cyrix 6x86mx.

John Russell

Senior editor Andrew Sanchez replies: *Voodoo^2 is designed for maximum speed. Unless you're packing at least a 266MHz Pentium II CPU, you will not see major performance increases between Voodoo and Voodoo^2. Take a peek at our full review of Creative's 3D Blaster Voodoo^2 and Diamond's Monster 3D II on page 72–73 for the complete skinny, where we have benchmark scores from a P-II 300MHz and a Pentium 233MHz system. The results will speak for themselves.*

Turning A Diamond To Coal

After reading your review of the NEC SPL 333, I'm curious: How is it that the Diamond Viper V330 actually performs worse on this system than on a system with a slower CPU, especially considering the NEC delivered high marks on all your other benchmarks?

Ray A. Geroski

Executive editor Jon Phillips replies: *These performance differences can be tied to video driver variations. A slew of Riva 128 drivers are floating around computerdom, as both nVidia itself and all the different card manufacturers have released and revised their own driver sets. It's possible that as some of these drivers have matured, the developers have sacrificed performance for increased stability. It's also possible the NEC SPL 333 was running with more system overhead than the Micron XKU 300.*

Got Nothin' But Love For Ya Baby

Are there any good P-II motherboards in the Baby-AT formfactor?

User467641

Senior editor Andrew Sanchez replies: *My fellow AT brother, times are getting really tough these days, with ATX becoming the formfactor of choice with newer mobos. I'll take it for granted you want at least a 440LX-based board, but the fact a Slot 1 CPU is so big makes finding a baby-AT formfactor board really tough.*

An exhaustive search has turned up a token few boards. I decided to leave SuperMicro's Full-AT Pentium II boards out of the mix, but if you have the room, take a peek at its Super P6DLF. We haven't tested any of these boards yet, but here are a few AT P-II boards:

Giga-Byte GA-686 BLX (440LX)
FIC KN-6000 (440FX)
M-Tech Stallion AT-M628 (440LX)
Micro Star MS-6118 (440LX)
Soyo SY-6KF (440LX)
TMC AI6NL (440LX)

As far as the next-generation of 440BX boards, many board makers are hesitant to produce an AT formfactor BX board.

Paint By Numbers

1. Are there any dual Slot 2 motherboards?
2. If so, will Win98 be able to use both CPUs?
3. If not, how do you tap that power?
4. If I get a dual Slot 2 motherboard, will it work on one processor if I only have the money to get one to begin with or do I have to get two?
5. If I get two, do they both have to be the same MHz or can I mix and match?
6. Can I use a Slot 2 Deschutes with a Slot 2 Pentium II?

Phillip MacMillen

Senior editor Andrew Sanchez replies: *1. All the major manus will make single-, dual- and quad-CPU mobos.*
2. Nope. Win98 only supports single CPUs. You'll have to use NT.
3. With Win98, you won't. You need two things to take advantage of that second processor: an OS that supports multiple CPUs—such as NT—and a program that takes advantage of multiple processors. Usually, that'll be high-end 3D rendering packages such as Lightwave 3D and SoftImage.
4. By Pentium II processor, I take it you mean Slot 2 Deschutes, so the answer to that question is a big positive. You can run a lone CPU in a dual CPU mainboard.
5. No mixing and matching allowed. The CPUs must be the exact same speed and cache size—no exceptions.
6. Slot 2 Deschutes = Slot 2 Pentium II. They're the same thing.

"Upgrading is the nature of the ***computer-gaming beast***, people. Bigger, better, faster games require more horsepower."

Truth In Advertising

I just finished reading your review of our backpack bantam CD-ROM drive (*boot* 18), and I have to say I'm disappointed. According to your review, backpack bantam is easy to install, easy to set up, and easy to use. That's exactly the point of a parallel port unit. Unfortunately, the other half was spent talking about how it's not fast enough.

It seems there was some confusion about the packaging we use to describe bantam as the fastest parallel port CD-ROM drive on the market. We never claimed a parallel port device would deliver the same speed as an internal device. Your reviewer received a 5.6x rating, and for a parallel port drive this is excellent. With the label, we were trying to explain to consumers that there are other parallel port drives out there claiming to be 8x or higher and that it is almost impossible to measure a parallel port in x's above 6x.

We know there are a lot of people out there still running on slow machines (with 4x or slower CD-ROM drives) or on notebooks or desktops with no CD-ROM drives at all. For these "jammy bastards" (as you so affectionately called these readers), bantam adds CD-ROM capabilities without affording a whole new machine or working in the guts of their computer to install a drive.

Debbie Armstrong, Micro Solutions, Marketing Manager

Editor in chief Brad Dosland replies: *The chart provided on the backpack bantam box shows a gauge with an arrow pointing beyond 24x. That is clearly deceptive advertising, and we stand by our criticism that the drive fails to deliver on that promise. And the 91% CPU utilization makes the drive worthless for all but application installation or document retrieval; it's certainly not suitable for the video streaming and game playing people frequently demand of their CD-ROM drive.*

And we still believe any boot reader living with a sub-4x CD-ROM drive or afraid to open their system to install better is a "jammy bastard." But we're here to help them.

Whiny Happy People

I just read the letters from the readers whining about the obsolescence of their 200MHz MMX systems, and I must say those people annoy me.

Upgrading is the nature of the computer-gaming beast, people. Bigger, better, faster games require more horsepower. If you don't want to upgrade for a while, fork over more than $3K for a system. But beware: it too will be outdated in two years or less.

The other option is to constantly upgrade.

Either that or stick to *Doom* and leave the rest of us alone. If you don't have the money to play, don't bitch about it. Get a job that will allow you to keep up with your habit or stop upgrading and play *Doom* the rest of your life.

Trey Dismukes

More On This Story As It Develops

Did you know that if you turn your empty plastic CD envelope over it spells "POOF"?

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Your Motherboard Rocks.

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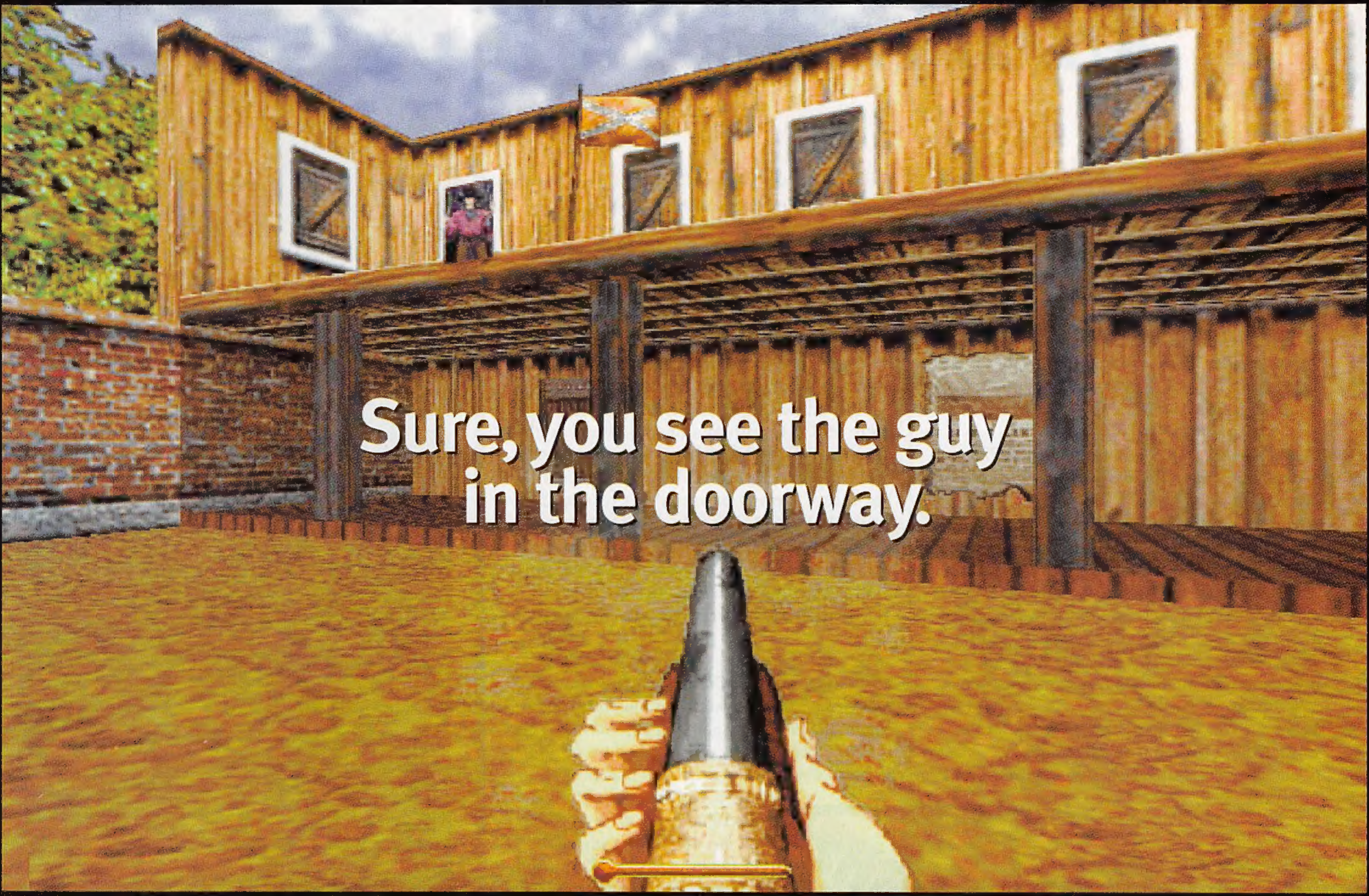
Your Drive Is HUMONGOUS!

Your System Crashes.

Product Information Number 122



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Computer Shopper Top 100 1997

PC Computing ★★★★

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Monster sound
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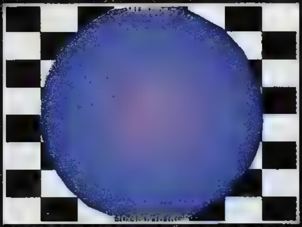
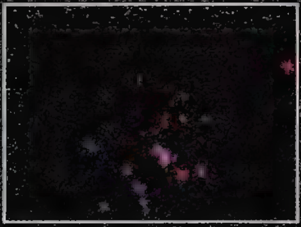
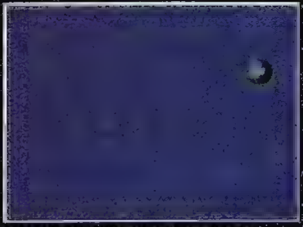
3D FEATURES DEMO



ATEST The ATEST sample was created to let developers experiment with transparency effects using alpha polygons. The sample starts with a standard blue sphere and Src Alpha and Dest Alpha menus. Choosing Src Alpha=SrcAlpha and Dest Alpha=InvSrcAlpha produces the standard transparent effect.



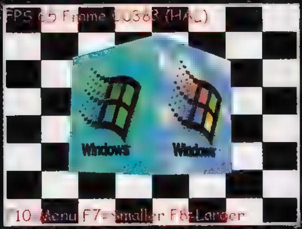
BEES BEES demonstrates two effects: emmissive materials and swarming behavior. The emmissive material effect creates the illusion that an object is glowing. Swarming behavior makes individual objects appear to act as a group, producing an intriguing effect.



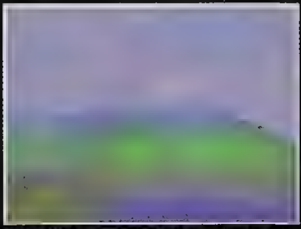
D-LIGHT D-LIGHT makes it possible to manipulate colored light sources in real-time. In the D-LIGHT sample, a single sphere moves along a path over the viewport, which contains black dots. The black dots represent light sources. As the sphere approaches, the dots activate and color the sphere.

Microsoft
DIRECTX

FLARE Lens flares are indispensable in a variety of simulations. Whether it's sunlight glinting off the windshield on a car in a racing sim, reflecting off the canopy of a plane in a flying sim, or flashing off the skin of a rocket in a space sim, this effect is a great visual enhancement. FLARE shows how to use alpha textures to produce a lens flare.

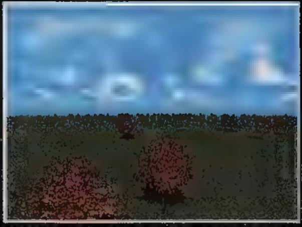


FLIPA FLIPA demonstrates the use of alpha textures with the standard spinning cube instead of a sphere. FLIPA lets you turn on alpha, specify an alpha texture, and use the Src Alpha and Dest Alpha menus to specify alpha-blending modes. The standard Src Alpha=SrcAlpha and Dest Alpha=InvSrcAlpha causes the cube to become transparent when using the alpha channel in the textures.



FOG FOG demonstrates both a rolling fractal terrain and the use of fog effects to hide the "edge of the terrain." Edge-of-the-terrain effects typically lead to "popping" unless hidden by fog or haze. Alpha fade is another technique that can be used to hide edge effects.

MIPMAP MIPMAP is a texturing technique used to provide multiple levels of texture detail. The MIPMAP sample shows how to create this effect. It also provides a graphic demonstration of the resulting improvement in quality by presenting a side-by-side presentation of both a mipmapped and unmipmapped object.



TREES One way to simulate complex objects is suing color-keyed billboards. This sample uses TREES to show how color-keyed billboards work. The TREES sample also demonstrates how simple shadows can be created using a similar technique combined with alpha-blending.

Longbow 2 Chopper simulations have reached a new level with *Jane's Longbow 2*. This helicopter simulation sequel has a new graphics engine with dynamic lighting, 3Dfx accelerator support, and multiplayer capabilities (including cooperative, head-to-head, and team play via Internet, modem, serial, or LAN). See the review in *boot* 18, page 89.

NORTON
AntiVirus
For Windows 95
SYMANTEC

Norton AntiVirus *Norton AntiVirus'* advanced scanning technologies come in the form of Striker, its polymorphic scanning engine, and Bloodhound, its heuristic scanner. Striker executes suspected viruses in protected memory and eliminates any bad seeds, and Bloodhound searches for unknown viruses by monitoring file structures and attributes. See the review on page 89.

PC-cillin
Anti-Virus

PC-cillin AntiVirus 3.0 *PC-cillin* scans, cleans, and blocks viruses from infecting your system and can do all this in the background without affecting the way you work. *PC-cillin* includes free lifetime updates online, *Office 97* compatibility, and it scans all e-mail messages and compressed files. See the review on page 88.

Quake II *Quake II* is pure unadulterated sex gliding across your 3D accelerator. Enticing you with an intricately modeled environment mapped with 8-bit textures, the game dazzles with an astoundingly realistic physics model and plies you with enough colored lighting to make you giddy. See the review in *boot* 19, page 77.

Satori *Satori* lets you work with images of any size without sacrificing performance. You can load 100MB+ images in just a few seconds and edit them without processing delays—even using basic Pentiums with only 32MB of RAM. *Satori* has built-in painting, drawing, 2D graphics, and compositing tools—all in one application. And best of all, THIS IS THE FULL VERSION, NOT A DEMO. The Serial Number is PCP1197.

TrueFace
Miros

TrueFace PC Do you have a face that only a computer could love? Using any video camera and *TrueFace PC*, a user can secure PC log ons using their face. *TrueFace PC* is allegedly hack-proof. Users cannot get around it by rebooting or going through Windows safe mode. Unsuccessful hack attempts will be logged on the computer's hard drive. See the review on page 85.

NO CD? WE CAN HELP

Fear not if you're holding an edition of *boot* with no *bootDisc* CD-ROM. You can subscribe to the full magazine/CD-ROM bundle, and even order individual copies of the *bootDisc*, by calling customer service at **800.274.3421**.

Each month, the *bootDisc* is stuffed with game demos, application demos, utilities, and patches—so don't miss this treasure trove of valuable software.

Steroids for Cyber athletes
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DVD Edition
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(features MMX™ technology)
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82440LX chip set
512KB internal cache, 2MB BIOS
3.5" floppy
32X EIDE variable speed CD-ROM drive
128-bit AGP 3D video with 4MB SGRAM
32 voice PCI Wavetable sound, stereo speakers
56Kbps data/fax modem*
104-key enhanced keyboard
Microsoft® IntelliMouse™, USB connections
Microsoft Windows® 95 and MS® Plus!
Microsoft Home Essentials
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Millennia 333 DVD Edition

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19" Hitachi Superscan CM751 monitor (18" display)

82440LX chip set
512KB internal cache, 2MB BIOS
Integrated 100MB Iomega Zip drive
3.5" floppy
DVD-ROM drive and PCI decoder card
128-bit AGP 3D video with 4MB SGRAM
AWE 64 ISA sound card, speakers with powered subwoofer
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*Maximum transmission speed of up to 56Kbps when downloading data and 33.6Kbps when uploading. However, actual performance is dependent upon numerous factors and observed transfer rates may be less than the maximum potentials.

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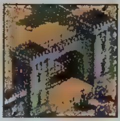
NUGGETS

Gamestock 98

Microsoft looks poised to turn some heads at this year's E3 show, based on what *boot* saw at the Gamestock 98 event.



Of the 14 new games slated for 1998 release, two—*Asheron's Call* and *UltraCorps*—were designed specifically for Microsoft's Internet Gaming Zone. *Asheron's Call*, a first-person RPG with an open-ended storyline and traditional elements such as magic spells, hand-to-hand combat, and experience points, promises a gaming environment that can easily support thousands of players. The game will go live by mid-1998 with both daily and monthly fee structures. *UltraCorps*, a turn-based "world domination" strategy game, will be available later in 1998 with only a monthly pricing option.

As expected, *AOE 2* (with a projected fall release date) looks mighty impressive, sporting a much more intelligent AI and multiple aggression levels. Play will take place in the Dark, Feudal, Castle, and Gunpowder Ages.

Monster Truck Madness 2 adds nine new trucks, new tracks, and support for MMX and AGP.

Other new projects include *Spitfire*, using an updated and weaponized Flight Simulator engine; *Urban Assault*, a complex, first-person, action game; and *Outwars*, a jet-pack-based arcade game.

Baseball 3D—originally slated for last year—is now penciled in for an April opener, and based on our first-at-bat, the game appears to be worth the wait. *Baseball 3D* will require a D3D-compliant 3D card.

Jazz Multimedia's Next Videocard Swings Both Ways

Jazz Multimedia has announced the Outlaw 3D/Bonnie & Clyde, the world's first dual-bus video graphics card solution.

With a suggested retail price of $149, Bonnie & Clyde utilizes the same Rendition Vérité 2200 chipset as the Outlaw 3D card released in early February. But this time out, the board will have both AGP and PCI expansion buses on the same card. The Outlaw 3D delivers resolutions of up to 1600x1200 in 65K colors at 60Hz to 75Hz and fill rates that exceed 45 million pixels per second. An extremely powerful 100MHz memory architecture allows the Outlaw 3D to support 4MB, 8MB, or higher memory configurations. The V2200 processor also includes a 230MHz RAMDAC and clock generators.

While the dual-bus feature is admirable, AGP advocates won't be able to store and execute texture maps directly from memory, as the current V2200 architecture is a 1x/DMA design. Without this, Bonnie & Clyde will ultimately use the AGP port as a faster bus—nothing more. This may explain why the V2200 was chosen for this ménage-à-deux bus architecture.

AT&T To Offer Internet Telephony

When Vocaltec's Internet Phone software debuted in 1995, IP telephony was just a burgeoning market. But since then, the market has grown to $10 million, and it's expected to rise upwards of $2 billion by 2004, costing traditional long-distance providers $3

15 >

Quinta And Seagate Create New Hard Drive Technologies

NEW DRIVES TO ACCOMMODATE 40GB OF DATA

Early this year *boot* reported that IBM researchers had found a way to cram 11 billion bits of data onto a hard drive platter, doubling their own previous record of 5 billion bits. Pretty cool stuff. But they've been one-upped by Quinta (a wholly owned subsidiary of Seagate Technology), which recently announced it had managed to store upwards of 40Gb of data, or four times as much data, in the same square inch.

Quinta's breakthrough is based around its Optically Assisted Winchester technology, the first to integrate optical, magnetic, and telecommunications technologies in one drive. These new technologies enable Quinta to break the superparamagnetic limit. Or in laymen's terms, the point at which traditional hard disc media can no longer hold a stable domain.

Here's how the drive works:

An advanced light delivery system uses fiber optics to span the drive's actuator arms to carry light pulses from the optical switching module to the read/write head. This makes the drive head small and lightweight, since the actual light delivery system doesn't need to be on the actuator

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V.90 Modem Spec Finalized

THE 56K WAR IS OVER

K56flex
V.90
X2

The 56K "standards war" was the most expensive in modem history. The battalion from the 3Com/U.S. Robotics' X2 camp waged a media jihad with Rockwell/Lucent's K56flex that left many potential customers shell-shocked and too confused to buy. Fortunately, the war is over and peacetime prosperity is upon us.

The V.90 standard blends the best elements of both X2 and K56flex, which were not that radically different to begin with. USR's data encoding engine (multiple modulus conversion) was adopted. K56flex camper Motorola contributed convoluted spectral shaping of the downstream signal, which improves transmission of encoded analog signals over the public telephone network.

V.90 also incorporates nonproprietary improvements in line-condition detection, allowing the modems to connect at higher speeds more often. "V.90 is a distinct improvement over either X2 or K56flex," says Dean Grumlose, K56flex product line manager. Interoperability tests between Rockwell and 3Com/U.S. Robotics V.90 modems "are hitting 50Kbps-plus connections," adds Rockwell's Eileen Algaze. The bottom line is a more robust 56K standard that every modem maker can implement, without having to pay licensing fees to Rockwell or 3Com.

Vendors eager to recoup sales lost during the 1997 mass confusion almost instantly began shipping new V.90 modems priced as low as $99.

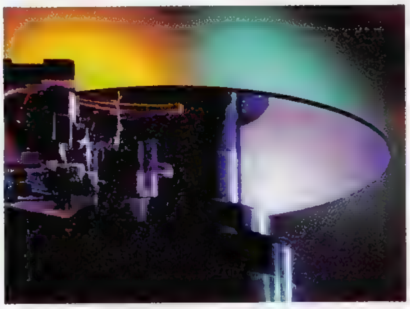
arm itself. An Optical Switch Module is responsible for generating light pulses and switching the laser-based light network used to highlight the data on the media surface between the actuator arms, all in as little as 1ms.

A unique head design integrates magnetic head technology with micro-optic lenses. These lenses focus the fiber optic's light pulses onto the media surface and are the smallest lenses ever created, with a diameter of less than 350 microns.

Micromachined (MEMS) mirrors reside at the end of the actuator arm and reflect light through the objective lens from the fiber optics running along the actuator arm. This mirror rotates and shifts the destination of the light to allow for minute adjustments between tracks on the media surface without any movement of the actuator arm. Track densities exceeding 100,000 tracks per inch are believed attainable with this technology.

Of course, this technology comes at a price: a new generation of storage media—similar to traditional Winchester media—will be required. Media made of plastic, instead of aluminum substrates, would make for lighter and less expensive drives, and a plastic substrate would allow such OAW media to be preformatted to include a servo pattern.

Quinta and Seagate expect to have actual product announcements sometime in the third or fourth quarter of 1998. But while they won't hit your PC for at least one to two years, this new breed of drives should theoretically be able to deliver data faster than current hard drives, with data capacities reaching over 100GB with multiple platters.



The technology is exciting—100GB hard drives, anyone? Too bad we'll have to wait a year or two for it.

Buyers of X2 and K56flex modems were promised upgrades to V.90, but in the rush to get new revenue-generating products out, vendors gave upgrade software second priority. However, most vendors plan to have downloadable software upgrades on their web sites by the time this issue of *boot* hits newsstands. Only a few early-1997 K56flex modems will require a trip to the factory for a chipset swap. *boot* readers who own nameless OEM modems should contact their system vendors for V.90 upgrade information.

Before you jump the gun and upgrade your current hardware, consider this important fact: backward compatibility. If you switch to V.90 before your ISP does, you could lose your 56K capability. All but the lowest-priced modems have enough flash ROM to hold V.90 and either X2 or K56flex. Some vendors plan to support all three protocols.

The battle may have ended, but the smoke has yet to clear. ISPs, although enthusiastic about V.90, are cautiously testing various vendors' implementations before they upgrade their equipment. "As we receive V.90 software, we will be testing interoperability with end-user modems and AOL's mix of X2 and K56flex servers," says AOL spokesperson Jennifer Jaffe. CompuServe just began 56K rollouts in January and expects to upgrade 100 cities by April. "We will implement V.90 as software upgrades become available," says CompuServe's Janet Braumfield. ISP equipment makers such as Cisco, Ascend, and Bay Networks are giving first priority to enabling V.90 in new products, and software upgrades for existing modem racks are promised within days or months, depending on who you believe.

The most current, comprehensive source of V.90 upgrade information can be found at **www.56k.com.**

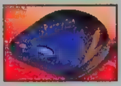
> "**V.90** is a distinct improvement over either **X2** or **K56flex**."
>
> *—Dean Grumlose, K56flex product line manager*

NUGGETS

> 14

billion, or 4% of their annual revenues.

In an effort to stop the bleeding, AT&T will soon be introducing WorldNet Voice, the first IP telephony service offered by a major long-distance company. You'll be able to make voice and fax calls though AT&T's Internet Protocol network, and you won't have to use your PC or Internet account to do it. Customers will call a local access number, enter an authorization code, and dial a phone number. Charges will be deducted from prepaid credit blocks charged to customers' credit cards. Each call will cost between 7 and 9 cents/minute. The service will be tested in three cities, (as yet unnamed), but will be expanded to 16 cities by year's end.



An alternate solution is the Aplio/Phone. Users dial a normal phone number connected to Aplio's $199 specialized hardware, a second Aplio/Phone answers, and then the two phones disconnect and log on to their respective ISPs. The phones rendezvous at Aplio's server, exchange IP addresses and commence a voice conversation. The benefit? Users can talk all day for the price of the first minute.

IBM's 1-Inch Hard Drive Breakthrough

IBM has announced work on a 1-inch hard drive that will hold up to 400MB but will cost a mere $200. The matchbox-sized drive would be targeted at consumer devices such as digital cameras, PDAs, and subnotebook computers. But unlike the flurry of recent announcements that push areal capacities with new patented technologies, this drive is based on existing ones, only slimmed way down.

It's designed to fit in a new 5mm high version of the CompactFlash socket defined by flash-card maker SanDisk, a format that uses an ATA (IDE) interface and a PC card–like socket. Although the product's still in the concept stage, IBM is hoping to have a working prototype at Comdex this fall.

Micron Abandons High-End Notebook Market

boot has confirmed that Micron Electronics will be eliminating its high-end notebook line—the TransPort XKE series—in favor of more slim-line and less-expensive models.

The company will be phasing out the XKE products (which scored a coveted 10 rating from *boot*) throughout the next couple of months, but will be announcing new products in April.

No word yet as to specific features or price points

Intel To PCI Chipset Makers: Back Off!

Intel may launch its deadliest weapons against competitive chipset companies—lawyers.

Intel has said it may pursue litigation against several companies over intellectual properties relating to Pentium II chipsets. According to Intel, any companies interested in developing Pentium II chipsets must license the technology, which is currently protect-

> 16

NUGGETS

> 15

ed by numerous patents. Neither Acer Laboraties, Silicon Integrated Systems, or Via Technologies—all of which have announced Pentium II chipsets—have done so.

Acer Labs' new product, a two-piece Aladdin Pro II chipset for Pentium IIs, will support Intel BX–like features such as the 100MHz bus and AGP 2x. Silicon Integrated Systems and Via are preparing similar offerings.

Prepare To Enter The 133MHz ESDRAM Zone

Enhanced Memory Systems has announced an agreement with Siemens Semiconductor to manufacture enhanced synchronous dynamic random access memory (ESDRAM).

The 16Mb ESDRAM architecture combines two 4Kb/12ns SRAM page caches and two 8Mb/27ns fast DRAM banks on one integrated circuit. The 12ns cache reduces SDRAM CAS latency from three to four cycles down to two cycles at 133MHz. The fast DRAM reduces both row-to-column (tRCD) and precharge (tRP) delays from three to four cycles to two at 133MHz.

ENTERING
SPEED LIMIT
133
MHz
ESDRAM
ZONE

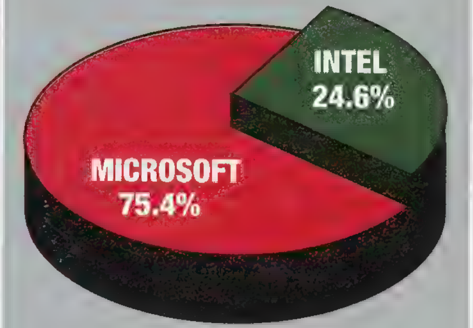
ESDRAM will generate peak bandwidths of greater than 1.6GB/sec and achieve twice the sustained bandwidth of either SDRAM or Direct Rambus.

Siemens also agreed to produce future-generation 64Mb and 256Mb ESDRAM products. It will enable EMS to support the demand for its 133MHz ESDRAM product as the industry standardizes on 100MHz and 133MHz SDRAM for the next generation of computer applications.

Production of 16Mb ESDRAM products is expected to begin in the second quarter of 1998. ESDRAM components will be manufactured on Siemens' high-volume, 16Mb, 0.35micron DRAM production process using 8-inch silicon wafers. b

boot OPINION POLL

Who is more evil? Microsoft or Intel?



If you're not a regular visitor to ***www.bootnet.com****, you should be. You're missing your chance to participate in boot's weekly opinion polls. Tell us what you think! We care, we really do! Thanks to all who responded.*

Intel's New Low-Cost And Mobile Technology

CPU AIMED AT **SUB-$1,000** PC MARKET

Intel's most recent debutante, formerly known as "Covington," is having a big coming out party. Targeted squarely at PCs costing between $800 and $1,200, Celeron is Intel's new cache-poor desktop Pentium II processor.

The Celeron is based on the same P6 microarchitecture as the Pentium II. It's electrically compatible with Slot 1, but there's no onboard cache and the chip is limited to a 66MHz system bus. Systems that incorporate the new chip will be limited in scope as well: the maximum memory supported is only 256MB (two DIMM slots), and there's no error correction code, advanced power management, or dual-processor support. Interestingly, Celeron also features a new single-edge processor package (SEPP), necessitating a new locking mechanism to secure the chip in place on the motherboard. As a result, Intel has created the 440EX AGPset, a variant of the 440LX AGPset core, to accommodate the new chip, which is slimmer than the case-enclosed Pentium II.

A 266MHz Celeron costs only $155. By comparison, the 400MHz Pentium II costs $824; and the 333MHz part costs more than $600.

This economy CPU follows Intel's lower-than-expected revenues and earnings for Q1 of 1998. When it came to recognizing the impact of the sub-$1,000 PC, which accounted for an astonishing 40% to 50% of all new PC sales last year, Intel was caught napping. To make matters worse, the "build to order" models recently adopted by many PC makers have also reduced excessive inventories and further slowed chip purchases. Worldwide economic slowdowns, especially in Asia, have also contributed to softer demand for PCs.

Systems incorporating Celeron should be available sometime in May.

Intel has also announced a 233MHz and 266MHz mobile version of the Pentium II, available in both mini-cartridge and mobile-module packages. Intel claims new price will emerge this year that previously didn't exist, and expects at least a 10% decrease in the high-end notebook market. As a result, the sub-$2,000 and sub-$1,000 markets are being heavily targeted.

pentium II
intel
82443BX
intel
pentium II
intel

Both versions of the mobile Pentium II processors integrate 512K of L2 cache. Other technical highlights include the reduction in both core and I/O voltages, lower power consumption, and a reduced footprint—the mobile version of the Pentium II is only one-sixth the physical size of the desktop version and approximately one-fifth the weight.

Notebooks incorporating this mobile marvel should be available in April. b

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- *Uses two ordinary phone lines*
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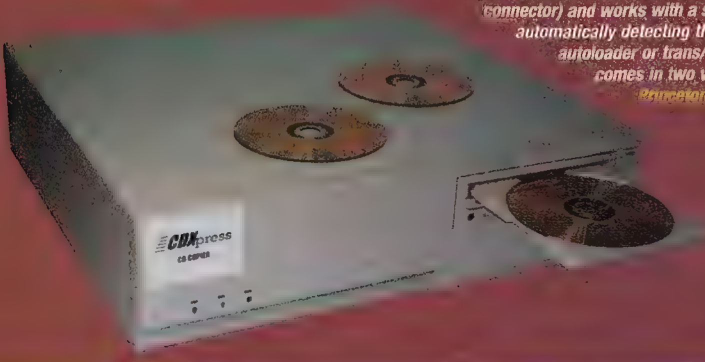

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MICROSOFT DEFECTOR TELLS ALL

THE SAINT

WITH ALEX ST. JOHN

What Makes **Bill** Tick

THE **INSIDE STORY** OF HOW THE MAN RUNS HIS **VAST EMPIRE**

During my tenure at Microsoft, I never hung out at Bill's house or swapped world domination stories with him over a brew. Still, in my time with the empire, I learned a lot from him.

The first time I encountered Bill was just two months after joining the company. I was their first publishing evangelist and had no idea what that meant. My first clue came when *PC Week* asked about Win95 printing. I had no experience talking with the media and made the mistake of being open and honest with them. Two weeks later, the front page of *PC Week* announced "Microsoft Acknowledges Windows Print Architecture Is A Mess."

I got e-mail from Bill himself that day, asking what the hell I thought I was doing saying something like that to the press and why hadn't I gone through PR.

I was devastated.

Just two months into the job, I was sure I was going to be fired. During a long walk around the Redmond campus jogging trail, something happened inside my head that shaped the rest of my career at the empire: I reconciled myself to being fired. It no longer mattered what I said or did, since I was gone anyway. I got mad and went back to my office and fired off a heated response to Bill's mail.

I said something like, "What the hell am I supposed to say to the press? Our printing system is busted. It's second rate to Apple's. Everybody knows it. How can I earn a jot of respect from the developers I'm supposed to be helping by denying the existence of problems that are as clear as the nose on their face?" Bill quickly responded that I was wrong. He had been assured that the Windows Postscript driver was superior to Apple's. I nearly did a spit take when I read that. Could Bill *really* be that deluded? "THAT'S THE MOST RIDICULOUS THING I'VE EVER HEARD!" I shouted back in e-mail, followed by a systematic litany of just how broken the print architecture and drivers were. Bill forwarded my response to nearly every Microsoft V.P. with a tersely worded comment to the effect that the new guy—ostensibly an expert in print technology—was contradicting everything he'd ever been told about the quality of Windows printing, and suggested that they meet with me to "sort it out."

My manager shot into my office shortly thereafter, looking ashen. I think he saw his career at Microsoft flying out the window with me. What followed was mail from every executive having anything to do with printing telling me effectively to shut up or to come to them if I had a problem with their technology instead of whining to Bill.

When it was over, the program manager for the NT print architecture had resigned, and Microsoft was in negotiations—for the first time—with its then arch rival Adobe to jointly build a new Postscript driver for Windows 95. And still, I was sure any day would be my last.

At the time, I resented Bill mightily for throwing me to the wolves. It was almost worse than being fired, but over time I came to realize what his world must be like and why he had to deal with things that way. Bill is surrounded by an enormous Reality Warp Field. Dozens of powerful people inside Microsoft attempt to control the information he gets, while looking good at all costs. Bill is, after all, the gravy train they rely on to make hundreds of millions of dollars in vesting stock options. Bill has to work very hard to keep a grasp on reality with so many budding millionaires persistently blowing smoke up his ass.

Dozens of people inside Microsoft attempt to **control the information** Bill Gates gets. He has to work very hard to keep a grasp on reality with so many budding millionaires persistently **blowing smoke up his ass**.

Contrary to my initial perception that Bill must hate my guts, I was increasingly in contact with him.

I found myself invited to sit in on the occasional technology review presented by other groups, and the pattern was always the same. The presenting group was terrified and meticulously prepared. They huddled at their end of the table, attempting to methodically make it through their PowerPoint presentation when suddenly Bill would interrupt with seemingly unrelated questions. If the speaker choked, Bill would get a look of deep scorn and start saying things like "That doesn't make any sense," or "Do you expect everybody to buy a Cray to run that thing?" The team leaders would usually stammer things like "We'll get right on that problem and get back to you," and Bill would leave, appearing irritated and vaguely dissatisfied.

ALEX ST. JOHN From his position as Microsoft's game technology evangelist, Alex St. John was responsible for the controversial DirectX APIs that have either taken PC gaming to the next level or were horribly broken, depending on your point of view.

I realize now what this was all about. However intelligent Bill might be, he could never hope to comprehend *all* the technology being made by every group in the company. There was really only one piece of information he ever needed out of these meetings: Were the people in charge going to execute, ship, and do whatever it took to be successful? Or would they choke when confronted by a seemingly insurmountable obstacle? The ones who choked inevitably took forever to finish anything, if they ever did. It was his test of fire to see if the people he relied on believed in themselves enough to weather anything.

Bill can't help but be what he is. He can't stop conquering the world anymore than we can stop breathing. He cannot resign from being Bill Gates and must spend the rest of his life dealing with it.

He can't micromanage 20,000 developers to make great technology, no matter how sincerely he wants it. The best he can do is hire the smartest people in the world, let Darwinian forces reign, and constantly challenge people to genuinely think about what they are doing.

In spite of being the world's wealthiest man, he still clings to the notion that he is in complete control. The recent pie assault he suffered in Belgium proves otherwise, and it must pain him greatly to admit it. b

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THE SCOOP FROM A MAJOR PLAYER

GAME THEORY

WITH T. LIAM McDONALD

The **Fall** of **PC Gaming**, Volume II

THE **METHOD** AND THE **MADNESS** BEHIND THE GOOD, THE BAD, AND THE **BUGGY**

T. LIAM MCDONALD is the all-knowing god of gaming. His mother still can't believe that he plays games for a living.

What's the source of the problems facing game developers? How can a handful publish outstanding products, while so many others churn out fatally flawed, or simply bad, games?

The answer is simple: game development has yet to evolve an effective production model. The set of procedures, checks, and balances is fundamentally flawed. This is partly because the medium is relatively new and still evolving, but that excuse only goes so far. Other new technologies—manufacturing, medical, and high-tech industries—have found a working model and stuck to it. Unfortunately, not many game designers have adapted to the production model that's grown over the past 15 years.

In the old days, a lone coder, such as Sid Meier, Richard Garriot, or Norm Koger, would sit down and make a game, largely on his own. These auteurs were design, art, sound, code, and QA all in one. As the multimedia aspects of gaming moved to the fore, more people had to be added to the equation. Sound effects, music, 3D modeling, FMV, and textures soon made the role of the pure designer much more difficult. They could no longer tweak their game as they went along, or start without a script, or make sweeping changes late in development. The interrelationships between each element meant retrofitting would wreak havoc. Yet many developers still go blithely on, coding without a locked-down design or changing the design as they go. This is the road to catastrophe.

Many developers still go **blithely** on, coding without a locked-down design or changing the design as they go. This is the **road to catastrophe**.

Several recent failures prove this point all too well, *Descent to Undermountain*, *Red Baron II*, and *Starfleet Academy* were all in development for several years. As the games were shown to the press year after year, they kept changing. *DTU* was completely recoded. *Starfleet Academy* shipped missing many elements seen in previews. *Red Baron II* changed from an enhanced version of the original into a whole new game, with so many fits and starts along the way that it wound up being an unstable mess without crucial 3D support. Titles such as *Conquest Earth* have design, coding, and QA so botched that the game winds up feeling like an assemblage of half-finished components. All these problems are preventable.

These games were chasing the moving goal of technology without a firm, fixed design. Of course that isn't a guarantee of a quality game either, especially if that design is flawed, as it was in *Blade Runner*. But a smart producer will see those flaws.

They go into projects knowing precisely what they want. They know the end result before they begin, and they work with clean, efficient methods. In the case of *Seven Kingdoms* and *Gettysburg*, the work was largely that of one or two visionaries, who keep a tight rein on a small team. The approach of LucasArts and Origin on games such as *Curse of Monkey Island*, *Jedi Knight*, and *Longbow II* was that of seasoned veterans who had been down this road before and knew precisely how to work.

Developers easily lose sight of the big picture in concentrating on particulars, and it is the role of the producer to keep the whole gestalt in his head and direct the developers accordingly. In order to do this most effectively, they need to start with a design document before actual development begins. And I mean a *real* design document, not the wishlists I've seen parading as designs.

In film and television production, where I began my career, we planned and planned and planned before we shot one single frame. We workshopped the script, drew storyboards, visited locations, did test shoots, created lighting plans, rehearsed, and on and on.

Many developers do this. More need to, and they need to do it more thoroughly. They need to lock down that goal on paper and in working demos before proceeding to the first stage of actual development. Some think they are doing just that, but they alter the design along the way as they encounter "unexpected obstacles." There are no unexpected obstacles, unless someone fails to plan properly. If obstacles do occur in the development process, then a good initial design allows coders to work around problems, rather than changing the whole design and creating all new problems.

Code isn't a pencil sketch you can crumble up and toss in the wastebasket.

In film, the producer makes sure the show is running, and the director shapes the way it runs. Right now in the computer game realm, both these tasks are falling on the producer far too often. The producer/designer team is the ideal one, with the producer keeping the project on track and the designer steering the vision of the game. If the designer does the job right, he should do very little during the actual development.

Alfred Hitchcock planned his films so completely that he sat around doing nothing during the actual shooting. Gaming has yet to find its Alfred Hitchcock. b

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INVESTIGATING INTERNET ISSUES

ON THE LINE

WITH SHEL KIMEN

Programmers Defend **Java**

IN THE TRENCHES, AT LEAST ONE MAN IS WILLING TO **SPEAK OUT** FOR THE JAVA DREAM

I've been slumming around Seattle, combing Multimedia Gulch for developers who could explain just *why* Java has finally gone mainstream with the enterprise market (see last month's column). Needless to say, it wasn't hard to find 'em. At an arcade on First that stocks dollar beers and vintage video games, I found Jon Ross, an independent contractor for Accelerated, a small web development company.

Ross has been programming some ten years in x86 Assembly, C, and C++. But when asked his language of choice, he chimes in, "Java. There are things C++ does better, but in general I'd pick Java." While he acknowledges that it is possible to write programs that run faster with C++, he points out "If speed isn't super critical, they're equivalent as far as end results go. It's more a question of simplicity of development, and Java is easier."

When asked about programming Java for the Internet, Ross laughs and admits, "It pretty much sucks. Sun's write-once-run-everywhere is a crock. It's more like write-once-debug-everywhere. The whole Virtual Machine thing . . . ugh."

Any C++-caliber app would be hard pressed to run on more than one platform. In fact, you'd be lucky to get it to run on more than one browser. "But on the back-end, on the server, Java's great and we use it all the time. You can do cool server manipulation stuff and cool database traversal stuff. Again, because it's cleaner and most database systems interface really well with it," says Ross.

> While **Java was built around OOP principles**, C++ was **forced to incorporate** C methodologies in order to bring existing programmers into the fold. Ultimately, Java guides developers **better**.

The problem is that C++ carries a lot of C baggage—noise you don't need with an OOP (Object Oriented Programming) language, such as C, C++, and Java. Even C++'s creator, Bjarne Stroustrup, points out that it's no accident C programs can be compiled with a C++ compiler.

While Java was built around OOP principles, C++ was forced to incorporate C methodologies in order to bring existing C programmers into the OOP fold. This was a brilliant way to make the transition, but ultimately, Java better guides developers, or some might say restricts them, towards the OOP concepts.

"There's less room for error," says Ross. "For example, with Java, there's no such thing as a method not inside a class. You can't just have functions that aren't attached to anything else."

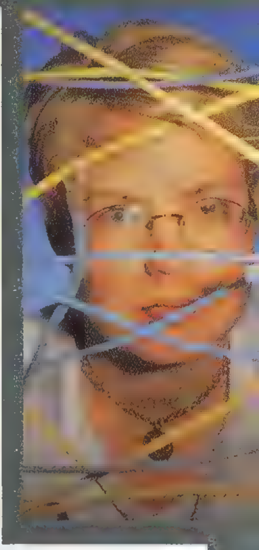
Java also enforces "exception handling." When a class opens a file, a zillion things could go wrong—hell, the file might not even *exist*. When you're programming, the function opening the file throws up an "exception" if something like this goes wrong. Programmers can ignore this exception with C++. With Java, programmers are warned and given the choice to either deal with it or continue throwing it up the chain. Ignoring the problem is *not* a possibility. The program won't compile if you don't address the problem.

While it's easy to see how some developers might find this annoying, in the long run it makes for cleaner code.

And this is one of the reasons enterprise companies use Java. Companies handling huge client/server database systems to track customers, financial information, and other mission-critical corporate goop cannot afford buggy programs. They cannot afford careless, albeit small, errors that have the potential to threaten revenue. Clean code is ultra important.

The enterprise market is also keen on standards.

Before Java, when Ross used to build interfaces to database systems, he had to deal with either "hacked-up, whacked-out CGI garbage" or highly specialized tools and languages such as PL/SQL to work with Oracle and VB/ASP to work with Microsoft. Not only are these immature languages with relatively fewer people developing and improving them than, let's say, Java, but there are also scant few debugging tools, and they're mediocre at best. There's maybe one tool each for PL/SQL and VB/ASP, but there are at least a half dozen very good tools for Java.



SHEL KIMEN no longer drinks coffee and can be reached at kimen@klever.org.

With more people investing in the development of Java, it's bound to have broader acceptance and better tools . . . duh.

In addition, the few programmers who excelled in these proprietary languages could charge, "like five thousand dollars a second because no one else could do it," according to Ross. From a bottom-line perspective, a more accessible language such as Java, with its more accessible tools and resources, makes sense to big business.

"I don't mean to imply that Java is going to make C++ go away," Ross notes. "There will always be uses for C++. Different languages are cool because the diverse concepts teach us how to solve single problems in a multitude of ways. But in most cases, Java is the most appropriate tool for me."

You can download Ross's genetic art screen saver (written in Java) from **http://www.nwlink.com/~jonross/** or contact him at jonross@nwlink.com. ▮

Image by Westwood Stu
Developed with Kinetix 3DStudio MA

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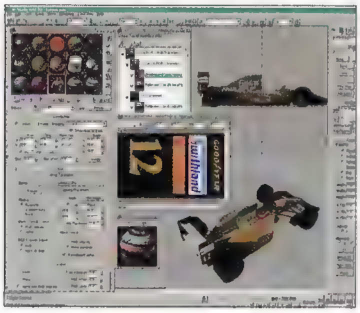

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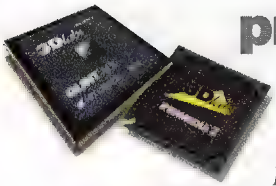

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FAST FORWARD

WITH TOM HALFHILL

Inside the **Mind** of the **IA-64**

YOUR **COMPUTER FRIENDS NETWORK** KNOWS WHAT YOU NEED BEFORE **YOU** DO

Your PC is psychic. When a program reaches a decision point—such as "OK or Cancel?"—the CPU actually *predicts* which button you'll push. Then it starts carrying out the instructions even *before* you click. And most of the time, it's right!

OK, it's not *exactly* psychic. But there's some weird science going on here.

It's called branch prediction, and it's just one technique engineers use to prod kick-ass performance out of CPUs. Some CPUs rely on static branch prediction: They simply predict that all branches will flow the same way (such as the "OK" path). It's dumb, but it pays off. More sophisticated CPUs (including the entire Pentium family) use dynamic branch prediction: They observe the program's flow and base their predictions on past behavior, which typically yields 90% accuracy.

Branches have always been a bugaboo for CPUs. They interrupt the smooth flow of a program and sometimes force the CPU to hunt for instructions and data outside its caches (a cache miss). But without branches, software would be braindead. Branches are what make computers seem quasi-intelligent.

The vast majority of branches don't require a decision. Instead, the program decides which fork to take, based on earlier input or some other data it has. On average, a program contains a branch every five or six instructions. That means a program running on a 200MHz CPU might be evaluating ten million branches per second.

On average, a program contains a branch every five or six instructions. That means a program running on a 200MHz CPU might be evaluating **ten million branches** per second.

When a CPU guesses wrong, it pays a heavy penalty in wasted clock cycles. The CPU must discard the results of any executed instructions beyond the mispredicted branch, reload its pipeline with new instructions (often causing a cache miss), and start over.

Here's an analogy. Suppose every Friday you deposit your paycheck at a neighborhood bank. An alert teller who notices this pattern might fill out your deposit slip as soon as you enter the door. (Yeah, this is a fairy tale.) When you reach the teller window, the deposit slip is ready and the transaction takes less time. That's dynamic branch prediction. But if you make a withdrawal instead of a deposit, the teller has to throw away the deposit slip and fill out a withdrawal slip while you wait. That's a mispredicted branch penalty.

IA-64 chips will try to avoid that penalty by executing instructions along both forks of a branch, even before learning the outcome. When the CPU finds out which way the branch turns, it discards the results from the wrong fork and validates the results from the correct fork. You might reasonably ask, "But doesn't that mean the CPU *always* wastes cycles by executing instructions it will throw away?" Yes, it does. But it's no big deal, because IA-64 processors will have several parallel pipelines that execute mucho instructions at the same time. Little or nothing is lost by discarding the invalid results, because those pipelines would have been idle anyway.

Now let's see how things work at the First National Bank of IA-64. Again, the teller fills out a deposit slip as soon as you walk in the door. At the same time, an assistant fills out a withdrawal slip. When you reach the window, one of those slips will always be what you need. Your transaction goes smoothly. Yes, one slip always gets thrown away, but it doesn't matter. The teller or the assistant would have been idle before you got to the window anyway. That's *branch predication* (not to be confused with branch *prediction*)—the same technique used in IA-64.

To make this work, IA-64 programmers will need special compilers that mark each instruction to indicate which fork of a branch it belongs to. The compiler will also rearrange those instructions in the most efficient order for the CPU. And the compiler will pack three instructions together in a single bundle. This is usually known as a long instruction word architecture, but Intel and HP call it Explicitly Parallel Instruction Computing (EPIC), because each bundle tells the CPU which instructions to run in parallel.

TOM HALFHILL is a senior editor at *Byte* magazine and the author of two computing books. He first became interested in computers during the disco era.

That's not all. IA-64 processors can also load data from memory before a program needs it. Again, this requires cooperation from the compiler. When the compiler sees an instruction that needs data, it moves the instruction that loads the data in front of the instruction that uses the data. Later, when the program runs, the CPU loads the data and holds it until the program needs it. This is called speculative loading.

None of this technology is new. Other processors do similar things, although I don't know of any that combine all these techniques in a single chip. But it's all new to Intel processors. The x86 chip in your PC has nothing like it. And though it's not immediately apparent, EPIC is designed to *simplify* the processor.

Today's CPUs have a lot of circuitry optimizing a program while it runs. IA-64 chips will shift more of that burden onto the compiler.

As a result, IA-64 chips can devote more transistors to parallel pipelines. Merced shouldn't have more than four pipes when it debuts in 1999. But by 2005, I expect to see IA-64 chips that can execute eight or more instructions in parallel, instead of the two or three instructions that a Pentium or Pentium II can handle. ▯

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*While **Intel** would rather be thought of as a friendly dolphin, most schools of thought see the CPU giant as a predatory shark in the relatively small pond of 3D hardware. So whether you're Intel's chum or just its chump, nothing will ever be the same in its wake.* boot *dove in with **Jay Sturges**, Intel's Platform Architecture manager, and **Brian Ekiss**, Graphics Marketing manager.*

ENTER TH

boot *Many people see Intel as a shark feeding on the many fish in the 3D pond.*

Sturges We don't have any goal to take over the entire 3D market. That's ridiculous. There are many market segments and there are different price/performance requirements in all those different areas. We have no plans to solve every one of those.

Ekiss We'd like to be thought of more as a dolphin.

boot *A dolphin?*

Ekiss Yeah, a big fish living in harmony with the other little fish.

boot *Well, a lot of those "little fish" have expressed the sentiment that Intel will legitimize the 3D market. Does it need legitimizing?*

Ekiss "Legitimizing" is a loaded word. We view 3D as very strategic. We view the gaming market as very important. We wanted to apply Intel technology and resources toward moving 3D forward. Not many players in 3D are really delivering this level of performance. We think there's plenty of room in the market.

And if AGP, the Intel 740, and the Pentium II processor legitimize 3D, then that is what we want to do.

Sturges Balancing graphics with a Pentium II processor is extremely important to Intel. The Pentium II delivers geometric information at extremely high rates and having a graphics subsystem that can consume them at that rate and deliver that result on-screen fuels the industry.

boot *Who do you consider your main competition in the 3D market?*

Sturges Right now everybody is comparing themselves to us.

Ekiss The Intel 740 has become the gold standard of the graphics chip industry. Other people are saying they're either cheaper than the 740 or faster than the 740.

"The **740's value** comes from >

boot *And that's a good thing?*

Sturges I think it's a *great* thing. Just to see the Intel 740 being used as the standard is in itself an endorsement.

boot *But do you look at one particular company and say "Wow! They're doing this right! We have to beat them at any cost."*

Ekiss No. We took a pretty big risk. Some chip vendors say, "OK, OEMs are telling us they have a $15 budget, so we need to build a chip that costs $10 or $8. That way we can

E BIG FISH

Sub-$1,000 PCs... Rad or Bad?

Ekiss I wouldn't call them rad. I think you need to spend a little more to get rad. Things get pretty interesting at about $1,500. Things get real interesting at $2,500. Things are smokin' at $3,000.

The combination of the Pentium II, the 440LX AGPset and the Intel 740... those three products really define this higher price. You can see the difference on your screen; it's a much more exciting and compelling PC to use over and above those $999 PCs.

make a little money." We decided to base our chip on a set of technologies and capabilities. And that was a balance for the Pentium II, to do 640x480, 800x600, etc., and a number of polygons/sec—425,000, 1.1 million polygons, etc.

And that costs $34.75, not $15.

***boot* nVidia made a big deal about Riva 128 being the fastest chip out there. i740 matches the Riva's speed, but exceeds its visual quality by a fair margin. How did you pull that coup off?**

Sturges We run multiple stages of the pipeline within the architecture itself, and we're running all the data in parallel. With Direct3D TL vertices, every element of that data structure is interpolated in parallel, and then it's done with very high precision, up to 2^{18} bits of subcolor and subpixel accuracy. Basically that allows extremely rich color detail visually and extremely rich texture detail. So that number, in itself, is about 64 times the level of detail of the current state of the art.

We also carry around 15 times the level of detail on texture space. We support all the way up to a 1,024 per side texture map. This allows photographs to be used as texture maps and mathematically show what is the right level of detail based on the viewer's distance from an object in 3D space.

> the Intel name itself. That brand is the strength."

We also balanced to AGP with a concept called "tile addressing," which allows us to take advantage of spatial locality within 3D graphics geometry processing. This widely known behavior allows us to be extremely efficient in our memory interface. So when we read and write data—local memory, texture space—we're achieving 90% efficiency. In essence we can achieve almost 500MB per second over AGP, the total peak bandwidth.

***boot* What do you think of Voodoo^2?**

Sturges Great arcade product. It really advances Intel's Open Arcade Architecture standard.

Ekiss This market is very interesting. It really defines the high-end and shows where PCs with Pentium II processors and high-performance 3D can go. It's a smaller marketplace, but we think it's a good one.

***boot* That's the marketing mumbo-jumbo. What about from a purely technical perspective?**

Ekiss It's cool. But 3Dfx doesn't have the right architecture for the mainstream PC market segment, considering it's a multiple-chip, PCI-based solution.

***boot* Is there one chip technology coming up that you're looking at and saying "Wow, this could actually be a real competitor to the Intel 740?"**

Ekiss Yeah... our next-generation chips.

***boot* But if you couldn't use an Intel-based card, what would you install in its place?**

Ekiss I'd go with a Voodoo^2.

***boot* That's 3D only. What about 2D?**

Ekiss For 2D? It doesn't really matter. Whatever my PC came with... I wouldn't bother to upgrade it. Screen sizes haven't gotten that much bigger, and bit blitz and line drawing are plenty fast and have been for a while. 2D matured awhile ago. We're going to keep playing the benchmark game like everybody else, but we don't see any end-user benefit in it.

***boot* Does a competitive 3D card need to target 90fps and beyond with today's games in order to deliver playable frame rates with tomorrow's games, with their higher polygon count and more intensive texture mapping?**

Ekiss The only reason someone would buy that kind of card is in hopes that over the next 12 to 18 months a significant number of applications catch up to that level. It's an investment in the future. It's saying, "I'm buying this card now and it's going to be good for three or four years."

Sturges The problem with using a single metric of frames per second is that it excludes quality-level and color-depth assumptions. For example, if applications emerge taking advantage of more texturing capability, yet your 90fps card only has 4MB and doesn't take advantage of direct memory execution, there will be no benefit.

Ekiss The only people that *should* buy those 90fps cards are software developers, and they should write their software to take full advantage of them.

***boot* Many of your competitors that we've talked with claim the i740 underperforms right out of the gate?**

Sturges The 740 architecture is highly efficient. At 66MHz, we generate 50 megapixels of fill rate. Current state-of-the-art mainstream performance is 50 megapixel fill rate at 100MHz—extremely inefficient. Not only are we hyper pipelined, where we carry multiple stages of pipeline throughout the whole chip, we're extremely wide. So we're carrying all the key data elements such as fog, alpha, and perspective correction in parallel in one pass throughout the pipeline. This allows us to deliver extremely high quality at a very high performance. We support up to 18 bits of subpixel and subcolor accuracy. That's 256K. Current state of the art is 4K. That's 64x greater color gradient accuracy.

***boot* If you could go back in time, how would you change the i740?**

Sturges We'd probably decouple the 3D pipeline from the AGP clocks to make it more asynchronous, then you could crank up the performance. We foresee well and above the 50 megapixel range in a very short period of time.

Ekiss I would love to have had it last September.

***boot* Word is Intel was three or four months late coming to market. Is that true?**

Ekiss We were shooting for the end of the year. It was a couple of months late, but out of an 18-month project timeline, that's normal.

***boot* How long was the 740 in development?**

Ekiss The development really got into full swing in May of '96. That makes it about a little over a year and a half in development. But that included building the team, building all the infrastructure, bringing the technology in, designing the chip from scratch.

***boot* How long is the life cycle of the typical 3D chipset these days?**

Ekiss Six to 12 months. After that it can live on if it moves to a lower market segment.

***boot* And how long is your development cycle for the technology itself?**

Ekiss It takes six to 12 months to do a spin of a technology enhancement; it takes 12 to 18 months to do a new architecture.

***boot* Do you think technology is moving too fast? Can consumers keep up? Should they?**

Ekiss I don't think any market can ever move too fast. If there's a lot of innovation and a lot of new products coming out, that's a good thing. It's up to the channel to deliver the product in such a way that it's not confusing.

But there must be demand for this rapid change from the consumer or it wouldn't be happening.

***boot* Just for the record, what does "i740" stand for?**

Ekiss The name of the chip is actually the Intel 740, but everybody else refers to it as the i740. And it's just a number—it doesn't mean anything.

***boot* And you haven't assigned it a name?**

Ekiss You mean like the "Cobra" or something?

***boot* Yeah.**

Sturges No. The value comes from the Intel name itself. That brand is the strength.

***boot* Intel did a great job of creating mindshare with the Pentium II, which translated into marketshare. 3Dfx won mindshare, but couldn't capitalize on the marketshare. Ultimately, which is more important, mindshare or marketshare?**

"The Intel 740 has become the **gold standard** of the graphics chip

Sturges Shipping in volume is definitely important. We're not interested in just building a name for the chip, we're interested in shipping them because when an end user buys the Intel 740 and the Pentium II processor, that's a compelling experience.

If we just build a name and don't ship any, it doesn't matter.

boot* *Sure, but isn't there a compromise between mindshare and marketshare?

Ekiss It's an Intel graphics chip. That's all we really want people to know. Our customers: Diamond, STB, Real3D, etc., are free to take our chip and put it in their brand. The only Intel brand related to that PC will be the "Intel Inside" brand and the Pentium II brand.

boot* *But don't you want consumers walking into a store and saying "I want a card with the Intel 740 chip"?

Sturges No. The Intel 740 contributes to the value of the Pentium II. It unleashes the Pentium II by working so well with the floating-point performance.

boot* *How did you decide on SDRAM over the sexier technologies, such as Rambus or DDR, that other card manufacturers are eyeing?

Sturges We chose SDRAM/SGRAM because it's widely available, there's lots of industry volume and accessibility, and it's well understood how you design with it.

And we're able to achieve the necessary level of performance. At 100MHz, we achieved 800MB/sec of peak bandwidth. At around 90% efficiency.

Ekiss One issue with Rambus is: Can it provide the sort of memory resolution that you need for a small, local-memory footprint? Or is it going to come only in large chips for system memory?

boot* *Does that tie in with why you limited the 740 to only 8MB?

Ekiss With the Intel 740 there's no reason to go above 8MB. Heck, in a well-architected chip we don't see any reason to go above 4MB.

Sturges We don't put textures in local memory. They stay resident in the system memory. The only real benefit would be higher resolutions and higher color depths.

Ekiss You'll see a mad rush to 8MB this year, but it'll be a marketing move because it's easier to sell. 8MB is, after all, bigger than 4MB.

boot* *But 12MB is even better than 8MB...

Ekiss It's hard to explain the deeply buffered AGP interface on the Intel 740 and tell people all they need is 4MB. But it's a conspiracy: You only need 4MB! Other chips need 8MB to get full performance, and that costs about $6/MB. And then there's usually a 3x to 5x markup. So worst case: $30/MB x 4=$120 for bragging rights to say you have 8MB. It isn't worth it, and you don't need it with the i740.

Our 2MB board competes very effectively with an 8MB board, so it's cheaper to implement for the performance you get. But frankly, it's hard for a board vendor to sell that. It's very easy to sell "bigger is better."

boot* *What are the limitations of a 2MB board?

Ekiss The only thing you give up is 1600x1200 2D resolution. And you give up triple buffering. Plus you give up 800x600 3D. If you're OK running games in 640x480, then 2MB is just fine.

But I don't think you'll see a lot of boards with 2MB; they'll be 4MB and 8MB predominantly, that's the standard in the industry right now. But AGP, when properly implemented like in the 740, doesn't need a big local frame buffer. Most chips point toward local memory. They're architected for local memory. They know how to deal with the low latency of local memory. They have big on-chip caches, lots of local memory bandwidth. This chip is pointed not only to local memory, but it's aimed at system memory. We have a very solid architecture in terms that we put in a FIFO, we put in these deep buffers, and we can execute very well out of system memory. So with AGP, we have, in effect, a dual ported graphics architecture.

boot* *Since Intel is the father of AGP, how much pressure was on you to show off AGP's full capabilities?

Sturges There was pressure to optimize and take advantage of the full capabilities of the AGP 1.0 specification and achieve the extremely well-tuned price/performance balance of the Pentium II processor.

*industry. Other people are saying they're either **cheaper** than the 740 or **faster** than the 740."*

boot ***Was Real3D's decision to do a PCI-based Intel 740 part a betrayal of the chipset's AGP roots?***
Sturges Real3D has created an additional component—a bridge chip—that goes from PCI to AGP, but it *wasn't* engineered by Intel.
Ekiss It's definitely *not* engineered by Intel. The Intel 740 chip is an AGP-only device.
boot ***Do you think having so many flavors of AGP has in any way hurt its acceptance?***
Sturges No, I think different price points are a good thing, whether it's AGP 1x, AGP 2x, or AGP 2x with direct memory execution. This allows AGP-enabled systems to filter into the marketplace at varying levels of price/performance.
Ekiss Users are going to get different levels of experience with different AGP solutions, and since AGP is not a brand, it doesn't reflect a particular product or level of performance. It's a technology and can be implemented in different ways.
boot ***Would you have preferred to have seen AGP launched at full 4x speed, as opposed to the incremental launch that happened?***
Ekiss The *boot* reader is going to be savvy enough to know the difference between a 1x and a 2x. I think other consumers are just going to be driven by price. And if they pay more, they're going to get more; if they pay less, they're going to get less. The market's pretty ruthless in that sense.
boot ***Do you fear AGP falling into the same chasm that MMX did, where developer support never really reaches critical mass?***
Ekiss I think MMX has been very successful. A lot of applications take advantage of it. AGP is also going to be very, very successful and widely used. You're going to see visible improvements because of AGP. We've shown a technology demonstration called *Rooms of Raphael* where you're in the Vatican, walking around looking at these extremely detailed frescos. It's very lifelike. That kind of thing couldn't be done until AGP. The difference between 2MB of textures and 30MB of textures is staggering. So AGP is definitely here to stay.
Sturges There's CPU instructions, such as MMX, and then there's platform-level instructions. And AGP falls in the category of platform-level instructions. AGP allows bandwidth-hungry 3D to emerge. And 3D is, by nature, very bandwidth-hungry, and there really wasn't enough of it on the PCI bus. It drove the need for AGP. Now I can create very rich, very detailed geometries. Before I'd create my hand with four triangles; now I can do it with 500.
boot ***What specs will be important in '99?***
Sturges In '99, you'll definitely see the emergence of 100 to 150 megapixel fill rates; you'll see two million triangles-per-second sustained rate.
boot ***How can someone overclock the i740?***
Ekiss We don't support overclocking. End users should be very aware of that and not buy boards with overclocked chips.
boot ***C'mon! That's just marketing bullshit!***
Ekiss [laughs] But I'm the marketing guy!
Sturges The core clock is the AGP clock, so on the current version the internal frequency wouldn't be easily changed. The memory subsystem could be changed, but it requires changing the video BIOS source, which only board vendors might do. We're considering decoupling the core. This would potentially make it easier to overclock.
boot ***Does Intel's fab history provide an unfair advantage over other 3D card companies?***
Ekiss I don't think we have any unfair advantage, but some of the technologies we bring to this are important. For instance, we have a feature called "Scan," which allows us to factory test all the transistors in the chip with hardware. We get a very low defect rate—about 1/10th the typical ASIC chip defect rate.
Sturges And we have Observation Architecture technology built inside the 740, which traps events. Developers use this to observe the graphics pipeline to tune their applications or their drivers to get the highest level of performance for parallelism between the Intel 740 graphics accelerator and the Pentium II processor.

"**3Dfx** doesn't have the right architecture for the **mainstream PC market** segment, considering

boot ***How important is motherboard integration to the success of the i740?***
Ekiss The Intel 740 is going to be seen mainly on add-in cards initially. And then later in the year you'll see it on motherboards from Intel and others.
boot ***Does Intel have any plans to converge its processors with this 3D technology?***
Ekiss We're definitely looking at whether that makes sense, but we don't have any products to announce right now.
boot ***From a price perspective, there's benefit to having the processor do video, audio, etc., but does this integration restrict you too much?***
Ekiss One of the trade-offs *is* flexibility.
Sturges Price/performance is ultimately why an implementation would choose software vs. hardware. The benefit lies in removing the dependency of peripheral hardware and any restrictions it may impose. The restriction of having done this in software is limiting what else you do [in software] at the same time.
boot ***What do you think of alternate technologies such as Oak or PowerVR or tiling-based architectures?***
Sturges Tile-rendering approaches ultimately try to minimze the bandwidth required to generate a sequence of scenes. The key limiter to widespread adoption is its methodology on content creation and the inherent unknown quality in realtime playback.
boot ***Does Intel ever persuade developers to support Intel technology while putting hooks into not supporting other technologies?***
Ekiss If we add some instructions or capabilities into our processor, we're going to encourage developers to use those capabilities because it's going to deliver better applications and better performance. But if we add something into a processor, there may be a time when no one else has it. That's just the way it is. That's innovation. We're innovating in our product. MMX was an innovation—we were the leaders with MMX technology, but it benefited the user with better audio and graphics.
boot ***How much does Intel interface with game developers?***
Ekiss We want to make sure applications take advantage of our polygon rates, and the features, the pixel rates, the scene complexity that an Intel 740 can do. If all game developers were supporting that level of performance, we wouldn't have any challenge. But only a handful of developers use the level of performance the 740 already has.
boot ***Why do you think developers are reluctant to take advantage of this power?***
Ekiss They have this mindset that somebody with a 90MHz Pentium system is going to buy their app. They're aiming for the installed base and not new machines. And that's the balancing act developers do.

When we started this, developers were still aiming for software-only 3D. They couldn't count on 3D chips—that was the bottom line. They were frustrated because too many 3D vendors had come through, promising performance levels and not delivering. We delivered the performance we promised. That raises their confidence that 3D graphics chips are something they can aim for and target in their app.
boot ***Do you target key developers?***
Sturges There are definitely people that understand the marketplace and the technology more so than others, and I really seek their feedback. For example, John Carmack.
boot ***John Carmack is on the record saying 24-bit color support is a key ingredient for Trinity, his next game engine, but the 740 can't do 3D in 24-bit color. When will you incorporate this feature?***
Ekiss We already put 3.3 million transistors in this chip and we felt *that* hit the right price/performance capability for 1998. We definitely agree that 24-bit color is a critical requirement for the mainstream performance segment in 1999.
boot ***What do you think of* Quake II*?***
Sturges It's very representative of the level of quality and performance available right

DVD... A Must or a Bust?

Ekiss DVD's an inevitability because it allows an 8x or 9x increase in storage capacity on the PC. And with Pentium II, the PC is capable of software DVD or MPEG-2 decoding and that makes the whole DVD thing a lot more affordable. And we see the crossover point, where more than half the PCs come with DVD drives, happening in '99.

now. And it really delivers a fun experience. It's very enjoyable.

Ekiss It's not enjoyable. I just like to blast guys! Doing it on the PC allows me to avoid doing it in the office.

Sturges It's a good place to vent frustrations.

boot ***Is there something you would've liked to have seen implemented in* Quake II *that wasn't?***

Sturges I'd have liked to have seen *Quake II* step up the level of quality with textures. Move toward more 16-bit textures, at higher resolutions, say 512x512, fully take advantage of AGP.

Ekiss They're still bridging from older hardware to newer hardware, and when Trinity comes out, they'll probably expect more.

boot **Quake II *is in the heat of the API wars. What prompted you to forego a proprietary native API and build around Direct3D?***

Ekiss Proprietary APIs create confusion for end users. They go to the retail store to buy the app and then have to figure out whether it works on their card. It's a recipe for mass confusion.

The beauty of OpenGL and Direct3D is that you have a lot of different chips innovating and competing beneath the API and a lot of applications innovating and competing above that API. So it frees people to do innovation and it makes it less confusing for the end user.

boot ***Does this mean that you're API-agnostic?***

Ekiss Between those two, we don't really care. Both are industry-leading APIs. Now if there's a third API that I don't know about that is in a position to be a leading API, we'd support that too.

boot ***That third API may very well be Glide. Any thoughts of writing to 3Dfx's API?***

Ekiss There were a lot of suggestions that we use Glide. But we looked at that, and the issue is that Glide is an exact mirror of another graphics chip: the 3Dfx chip. It's not a standard.

And it's yet a third API. It would have split the market up into three pieces instead of two and we decided that it would be better to consolidate our efforts on the leading ones.

Our decision to pursue OpenGL came out of that. So while the developers wanted it, it didn't seem to make technical sense when you really looked at it.

boot ***3D is currently associated with gaming. When will we see it move into more mainstream business markets?***

Sturges I'm already starting to see that.

Ekiss It's emerging because business developers see 3D being widely out there. Within the next year it's a standard part of a platform, if it's not already.

boot ***How do you see 3D being implemented in a business environment?***

Ekiss *ConceptCAD* from Virtus is one of the first business applications to use AGP. It's targeted at architects who want to create a simple model of a building. Then after spending a week developing a proposal, an architect exports it to AutoCAD and the engineers finish the designs.

Sturges *Viewpoint* with live art is another example. Not only is it gourad-shaded 3D, it can be rendered as works of art, whether it's inkwash, cartoon, or watercolor. You have control over the lighting, orientation, levels of zoom. The publishing industry should be extremely excited with that application.

Ekiss We have a vision for 3D. When you're dealing with a product—a three dimensional car, camera, watch, computer—you might want to look at it, turn it around, feel like you're touching it. And the web is going to be a key way for people to market products. The marketing department can develop those 3D models with point-and-shoot 3D. E-commerce and 3D are going to intersect here, but it's going to take some time as the technology pieces come into place. ▯

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TRIATHLON

The Definitive Test of 3D Hardware Speed, Form, and Endurance

You've read the raucous Usenet debates and seen the wild performance claims on product packaging—but now is the time to abandon the reckless postulation and identify the best 3D chipset, once and for all.

The 3D Card Triathlon is an exhausting contest of speed, form, and endurance. The competitors have been training since birth to master the conversion of complex x-y-z vertex data into explosions of texture-mapped polygons. And now the best of the best have gathered in the bootLab to determine who owns the 3D throne. No more guesswork. No more conjecture. The winners will silence all the fanatics who kowtow to brand loyalties and disarm the nattering nabobs who claim their dubious benchmarks tell the whole story.

We've invited six chipsets to the Triathlon—ATI's 3D Rage Pro, Intel's i740, nVidia's Riva 128, Rendition's Vérité V2200, 3Dlabs' Permedia 2, and 3Dfx's Voodoo^2. But since a chipset can't race solo, we enlisted what we considered to be the best implementation of each chipset—the videocard with the most-refined drivers, largest amounts of memory, and best extra features. Each of the six cards was placed in the same control machine and then run through the same grueling circuit. The first leg of the Triathlon tests sheer speed, the second inspects visual quality, and the third qualifies the feature sets that ultimately affect your buying decision.

The results might shock you, but neither the stopwatch nor the screenshots lie.

BY ANDREW SANCHEZ

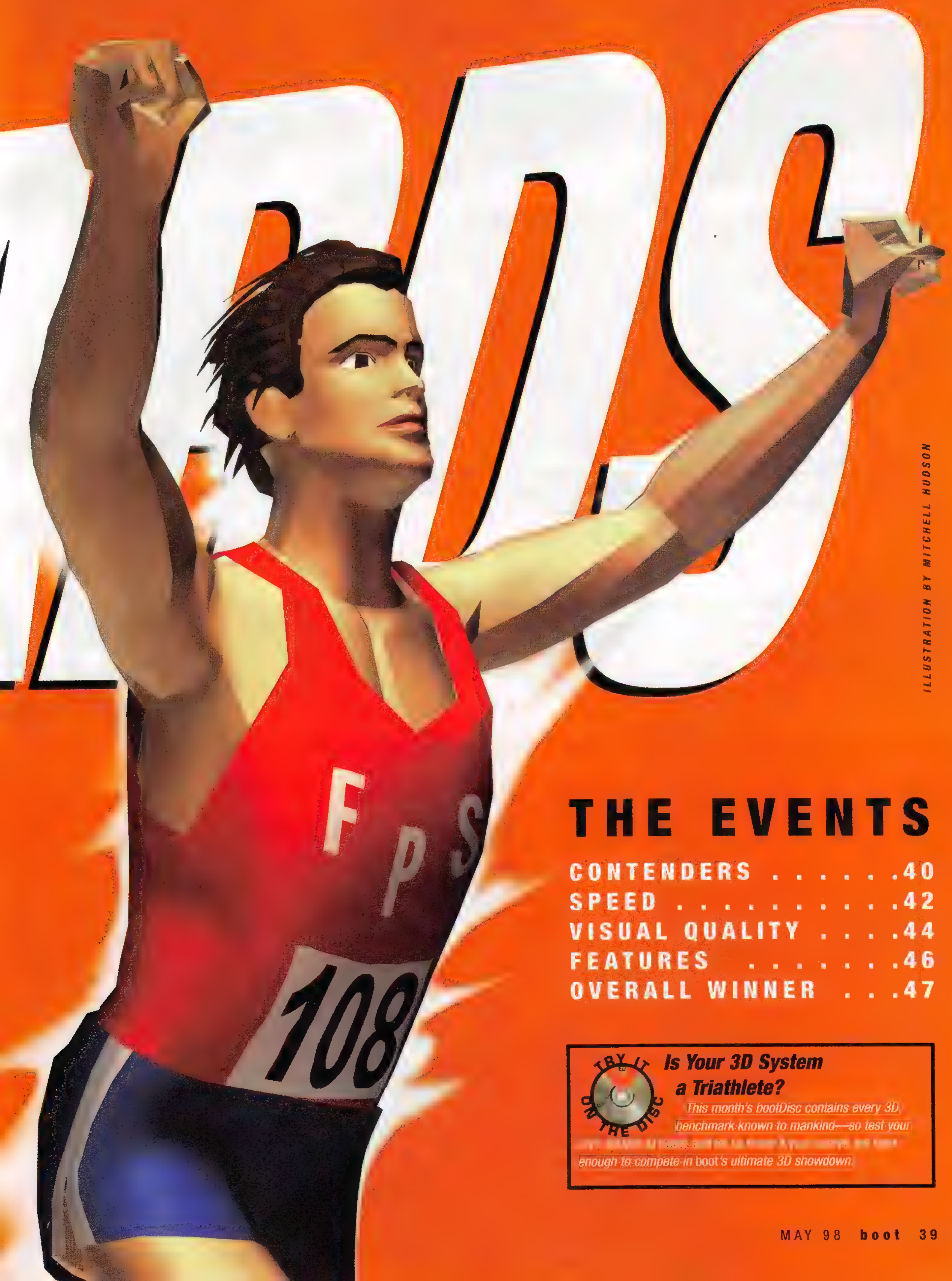

ILLUSTRATION BY MITCHELL HUDSON

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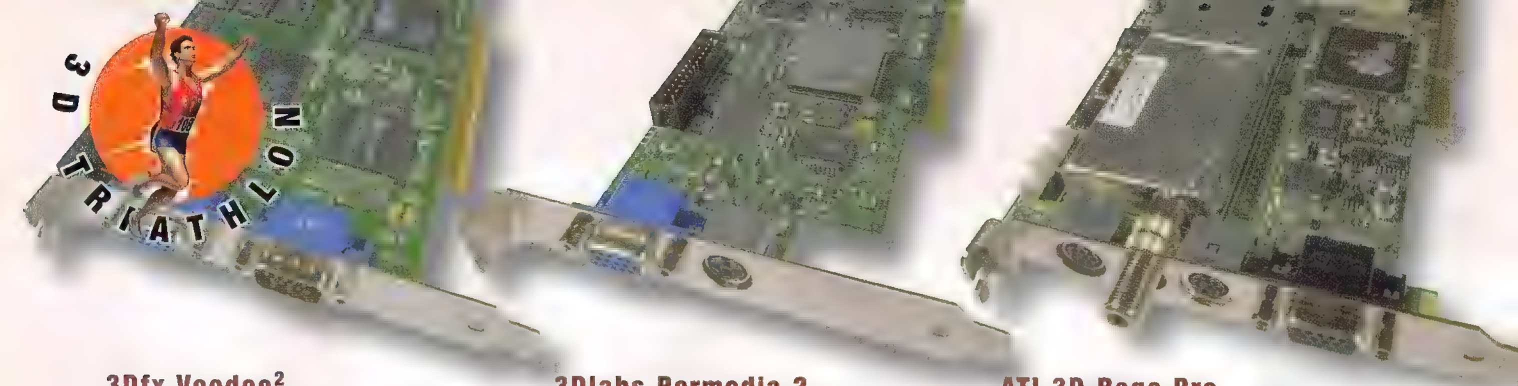
TRY IT ON THE DISC

Is Your 3D System a Triathlete?

This month's bootDisc contains every 3D benchmark known to mankind—so test your [illegible] enough to compete in boot's ultimate 3D showdown.



3Dfx Voodoo^2

An add-in board that builds on the original Voodoo's split-memory architecture, the Voodoo^2 introduces a second texelfx2 chip to help execute trilinear filtering, bump-mapping, and multitexturing, all in a single processing pass without a performance hit. The onboard 3D processor count thus rises to three pieces of silicon—two texelfx2 chips and one pixelfx2 chip. You can raise that processor count to six if you buy a second card for dual Scan Line Interleave (SLI) mode, which provides performance levels that best even arcade hardware. Voodoo^2 memory configs vary depending on the vendor, with the pixelfx2 chip getting 4MB standard and each texelfx2 chip getting either 2MB or 4MB EDO DRAM.

Creative Labs' 12MB 3D Blaster Voodoo^2 ($300, www.creativelabs.com) was invited to defend 3Dfx's almost undisputed reign. For the sake of the Triathlon, 2D duties were handled by Diamond's Viper V330.

3Dlabs Permedia 2

Known for high-end CAD/CAM GL accelerators, 3Dlabs has been training the Permedia 2 for the mainstream 2D/3D market. While it's aimed at entry-level GL-rendering environments, the chipset can also accelerate D3D gaming and 2D with equal aplomb, thanks to its 64-bit architecture, onboard setup engine, and support for 2, 4, 6, and 8MB SDRAM/SGRAM memory configurations. The Permedia 2 races over both the PCI bus and the AGP 1x/Execute circuit, and has appeared on many a videocard since its introduction in winter 1997. This is the only competitor to have a fully functional Win95 Installable Client Driver (ICD), so *Quake*-heads can just choose their default OpenGL driver and go crazy.

Diamond's 8MB FireGL 1000 Pro AGP card ($200, www.diamondmm.com) was invited to race for the greater glory of 3Dlabs.

ATI 3D Rage Pro

Based on ATI's long line of Rage chips, the 3D Rage Pro packs all the latest D3D features you can ask for, plus excellent TV-in/out. Offering memory configs of 2, 4, and 8MB of fast SGRAM, the 2D/3D part was the only AGP 2x chipset available for the better part of a year, making it popular with system manufacturers looking for the fastest AGP card. GL drivers—early and unpolished—arrived just in time for the Triathlon, so for the first time we'll be judging 3D Rage Pro performance and rendering quality under the rigors of *GLQuake*, *GLQuake II*, and *GLHexen II*.

Since ATI doesn't sell its chips to third-party manufacturers, we invited the AGP **All-In-Wonder Pro** ($400, www.atitech,com) and teamed it with the latest Turbo drivers, which supposedly give you a 40% increase in Direct3D performance. Speed aside, keep your eye on this versatile contender during the last leg of the Triathlon.

THE C

Representing the pinnacle of 3D hardware technology available on store shelves in early 1998, our six triathletes come from R&D labs far and wide, boasting the fastest frame rates and prettiest pixels available in three dimensions. While the Permedia 2, 3D Rage Pro, and Riva 128 have been in the sporting spotlight since late 1997, the Voodoo^2, i740, and V2200 have just arrived to make you think twice about your subsystem silicon.

chips in training

[illegible]

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nVidia TNT4

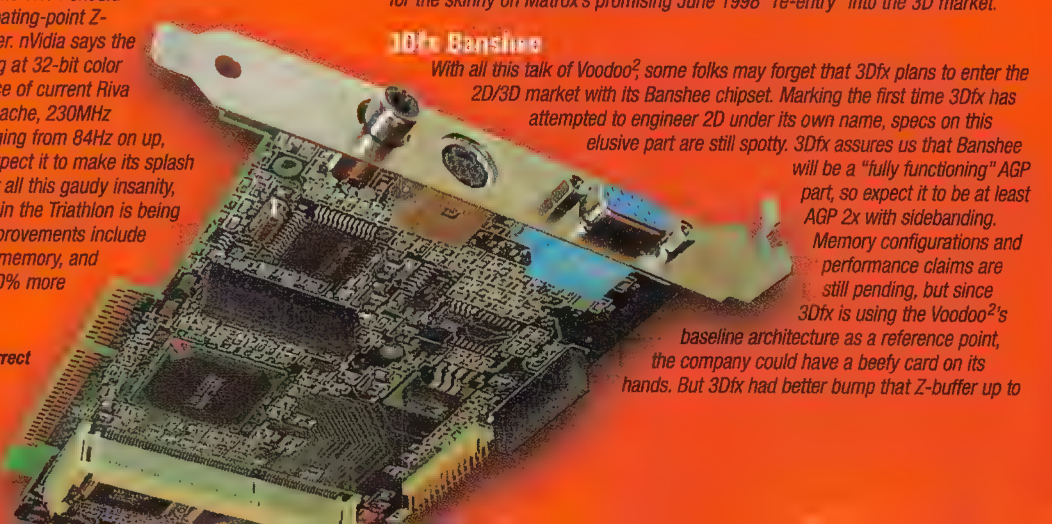
*First outlined in our Lip interview with nVidia's David Kirk (*boot *20), the 128-bit TwiN Texel 4 plans to outgun dual SLI Voodoo^2 performance. With full AGP 2x compliance and up to 16MB in tow, the TNT4 should pull off multipass texturing, 24-bit floating-point Z-buffer, and even an 8-bit stencil buffer. nVidia says the TNT4 will even do full-color rendering at 32-bit color depths—all for around the same price of current Riva 128 parts. Throw in 12K of on-chip cache, 230MHz RAMDAC, and processor speeds ranging from 84Hz on up, and the TNT4 promises the world. Expect it to make its splash around Q3 1998. If you can't wait for all this gaudy insanity, the current Riva 128 part competing in the Triathlon is being updated to the Riva 128ZX in Q2. Improvements include 2x AGP compliance, another 4MB of memory, and driver enhancements that promise 50% more performance.*

Matrox MGA-G200

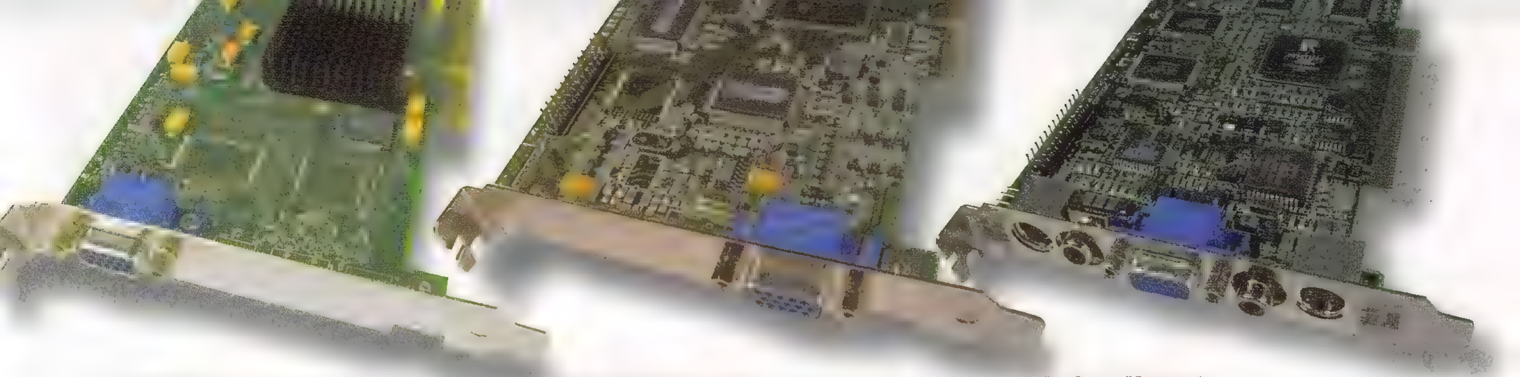
Coming out of nowhere is Matrox's next-gen 2D/3D accelerator, a chipset that proposes to bury all the ugly skeletons in Matrox's 3D past. The 128-bit processor works twin 64-bit buses in parallel, promising gamers Voodoo^2-like performance and game developers all the 3D features they could ever want to play with. On the 2D side, we're talking a 250MHz RAMDAC and up to 16MB SDRAM/SGRAM. Matrox says all this power teamed up with the wider bus path will give you almost twice the 2D speed of the celebrated Millennium II. See our preview on page 66 for the skinny on Matrox's promising June 1998 "re-entry" into the 3D market.

3Dfx Banshee

With all this talk of Voodoo^2, some folks may forget that 3Dfx plans to enter the 2D/3D market with its Banshee chipset. Marking the first time 3Dfx has attempted to engineer 2D under its own name, specs on this elusive part are still spotty. 3Dfx assures us that Banshee will be a "fully functioning" AGP part, so expect it to be at least AGP 2x with sidebanding. Memory configurations and performance claims are still pending, but since 3Dfx is using the Voodoo^2's baseline architecture as a reference point, the company could have a beefy card on its hands. But 3Dfx had better bump that Z-buffer up to



The MGA-G200 might completely resurrect Matrox's 3D reputation.



Intel i740

Packing all the visual goodness of per-pixel mip-mapping, the 2D/3D i740 was trained from the ground-up as an AGP 2x/Execute part. Since it uses a split-memory architecture, all local memory (in 2, 4, and 8MB SGRAM configurations) is used for front, back, triple, and Z-buffering duties. Meanwhile, all textures are stored and executed in system memory, so you'd better have a fast memory subsystem of at least 66MHz SDRAM for optimal results (and 100MHz, care of the 440BX AGPset, couldn't hurt). The i740 has been coached by engineers from Intel, Chips and Technologies, and Real3D. Look no further than Sega's Model 2 and Model 3 arcade units to see the locked-in 60fps fruits of Real3D's previous labor.

The i740 provides great visual quality and speed in a single chip. **Real3D's Starfighter AGP 8MB** board ($250, www.real3d.com) was invited to display the best performance the chipset offers.

nVidia Riva 128

Nothing beats 128 bits of processing power, and the Riva 128 does it all in a compact PCI or AGP 1x/DMA design that leaves other chipsets frozen in the starting blocks. Supporting all your favorite 3D functions except single-pass multitexturing, the Riva 128 boasts the only architecture in this contest that can store and execute textures from system memory—AGP style—regardless of bus. This makes even the PCI part an intimidating opponent. On the flipside, the chipset suffers from a 4MB local SGRAM ceiling, and the celebrated frame rates will cost you rendering quality, as we shall see during the second leg of our grueling Triathlon.

We would've loved to have invited Canopus's Total3D 128V, but the board was still in training during the qualifying rounds. **Diamond's Viper V330 AGP** ($200, www.diamondmm.com) thus competes to defend nVidia's good name.

Rendition V2200

Available in either a PCI or AGP 1x/DMA mode board, the V2200 builds on the programmable RISC-based processor of its Vérité predecessor. Its architecture handles many 3D algorithms internally, making field upgrades via microcodes a simple process. The core handles the majority of triangle set up, and can render a 12-attribute Direct3D pixel in a single pass. Support for both D3D and OpenGL guarantees few accelerated games go unplayable. Memory configurations allow from 4MB to 16MB of SGRAM, but expect 8MB to be the max for most consumer boards.

Hercules' Thriller 3D TH2218SG 8MB PCI board ($250, www.hercules.com) will represent the V2200 in competition. With full TV-output and stereographic shutter-glasses output packed onto a tiny board, the Thriller is the strongest PCI V2200 contender (no AGP parts were available during qualifying rounds).

ntenders

at least 24 bits, lest it get trampled by other 3D accelerators that are staking territory in the higher color-depth future.

Rendition 3D Conspiracy

By coupling Fujitsu Microelectronics' DSP-based Pinolite geometry processor with Rendition's V2200 accelerator, Rendition hopes to squeeze more power from the V2200 architecture before the next-generation V3000 hardware hits. The project is called the 3D Conspiracy, a whole new board design that should be shipping by the time you read this.

Moving geometry set up and lighting functions to a specialized processor such as the Pinolite will result in significant performance improvements. Practically all the calculations that occur in the 3D-processing pipelines—geometry set up, lighting, triangle set up, and rasterization—will occur in the accelerator instead of the host CPU.

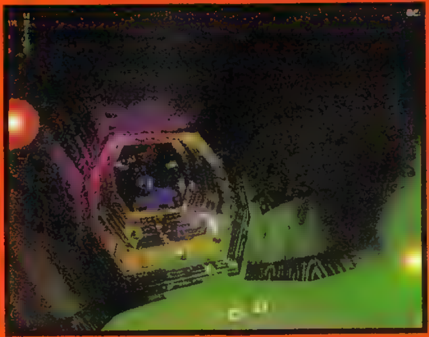
NEC PowerVR Second Generation

The technology once known as "Highlander" and "PMX1" has now been officially dubbed "PowerVR Second Generation" (PVRSG). In the original PowerVR architecture, the chipset consisted of an Image Synthesis Processor (ISP) and a Texture Synthesis Processor, while the CPU was left to chew on practically everything else. With the PVRSG, however, more functions have been brought onboard, including a hardware tile accelerator, plus ISP and TSP setup. The new chip supports anywhere from 2MB to 32MB of SDRAM and is based on a much-improved Z-bufferless, tiled-based architecture. A full floating-point geometry and texture setup engine has also been added, along with a faster 100MHz clock speed.

Unified frame-buffer/texture memory allows for environmental mapping. Multirendering is done on the back-end of the 3D processing pipe, so OpenGL and Direct3D games can take advantage of all those nifty lighting and reflective effects. Vector-quantization texture compression (around 8:1) and 32-bit floating-point Z-buffer accuracy round out the madness.

The new architecture is designed to be API-independent. Previously, D3D and OGL calls had to go through PowerVR's native API layer, SGL Direct, before being passed off into the 3D accelerator. A performance hit ensued. Now, all three APIs are treated the same. Since all ISP set up is now done in local silicon rather than in software/CPU, there's no need to go through an SGL Direct interpreter. This means games can now be programmed without worrying about what architecture is lurking inside the accelerator—it's all seen as conventional 3D, and all vertex-to-tile-based transformations take place inside the PVRSG chipset itself.

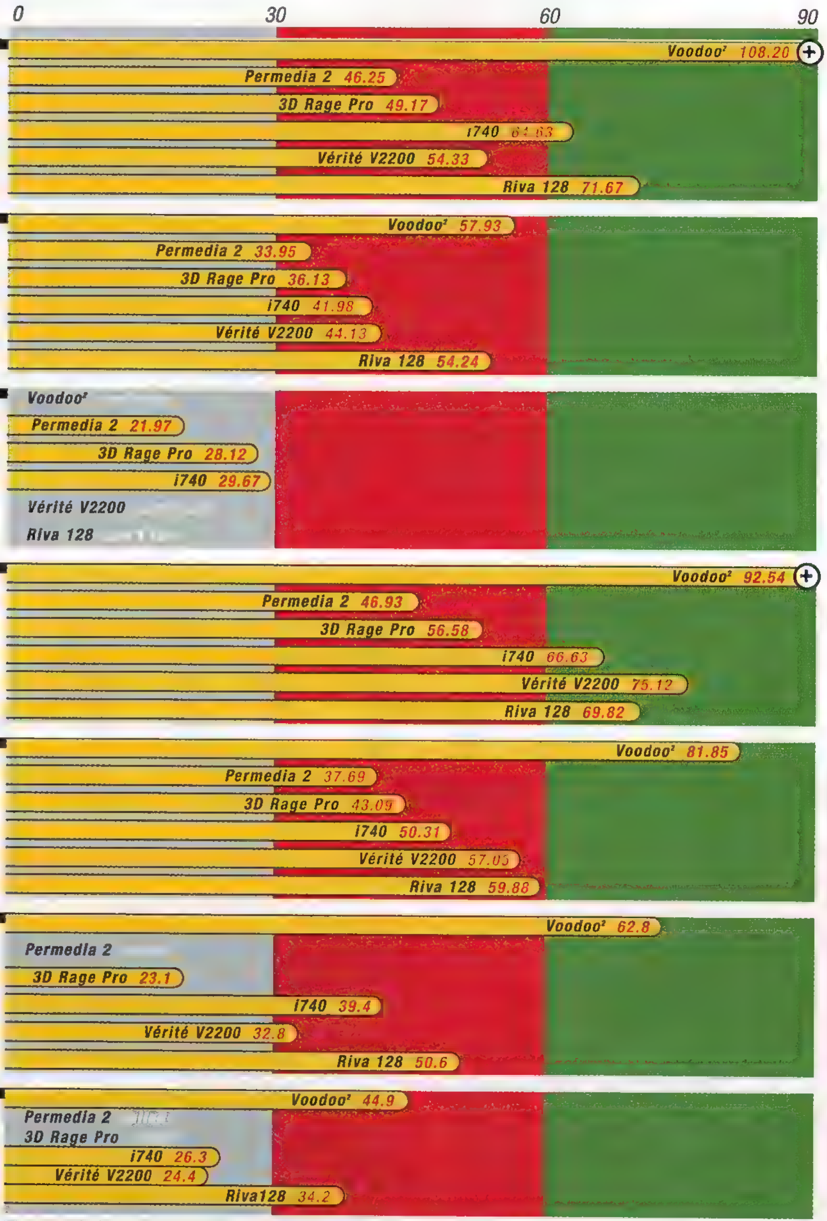
It's highly probable that VideoLogic will spank out PVRSG boards by July 1998. Once again, PowerVR is predicting cards under $100.



Forsaken *as rendered by PowerVR Second Generation.*

speed

The first leg of the Triathlon is an obstacle course through three Direct3D and three OpenGL games. Armed with the latest drivers, each card was placed in the same control system—300MHz Pentium II, 440LX AGPset, 64MB RAM, Win95 OSR2.1—and then pushed to pump the fastest average frame rates possible under varying resolutions. Forget about those contrived bungholioMarks—nothing indicates rendering speed better than good old frame rates. (The higher of our two scores was used for accuracy's sake.)



Forsaken/Direct3D at 640x480

Chipset-taxing effects include alpha-blending, transparencies, colored and blended lighting, and texture-mapped polygons. It pumps 3MB of textures through your system and makes an excellent visual-quality test when slowed down. Voodoo^2 finished first with 108fps, far ahead of the Riva's 71fps and the i740's 64fps.

Forsaken/Direct3D at 800x600

When run at 800x600, some competitors revealed they didn't have the endurance to compete. The Voodoo^2 finished first with a respectable 57fps, but check out how the Riva closed the gap with 54fps. The V2200 edged past the i740 with 44fps in this higher-res gauntlet.

Forsaken/Direct3D at 1024x768

Only the strongest made it this far, and those that did finish lost steam in the home stretch. While the Voodoo^2 can play games at 1024x768, it must do so without a Z-buffer, which Forsaken *requires. Ultra-high-res bragging rights thus go to the i740, which posted a hair below 30fps.*

X/Direct3D at 640x480

This game averages 2MB of textures and pumps many special effects, but doesn't push too many polygons, so scores above 60fps should be mandatory. Voodoo^2 once again placed first at 92fps, with a surprise second going to the V2200, which gathered courage to beat the always-speedy Riva 128.

X/Direct3D at 800x600

Bumping up the resolution to 800x600 proved to be no deterrent for the Voodoo^2, which once again placed first with a screaming-fast 81fps. Second place went to the Riva 128 with 59.88fps, which beat the Vérité V2200 by a mere two frames. What a finish!

Turok Dinosaur Hunter/Direct3D at 640x480**

This N64 conversion brutalizes accelerators with scads of alpha-blended weapons and animated humanoid polygons. A bit winded, the Voodoo^2 jogged into first with 62fps. Twelve frames later, the Riva ambled in, followed by the i740. Sadly, the Permedia 2 stumbled in the blocks and failed to run.

Turok Dinosaur Hunter/Direct3D at 800x600**

Once again, the Voodoo^2 flexed its silicon prowess—with a decidedly logy 44fps. The Riva and i740 assumed their respective Place and Show positions, but their frame rates were nothing to get excited about.

*The latest Vérité driver doesn't run 1024x768, though previous versions run this resolution.

**This is version 1.01 of the *Turok Dinosaur Hunter* demo. Do not compare old results with these new scores.

speed winners

Voodoo^2 Truly in a class by itself, the **Voodoo^2** won every single race in the speed competition, posting frame rates that leapfrog over the latest generation of contenders. There's no disputing this kind of performance—but the power does come at the price of the three processors and scads of EDO DRAM sitting onboard (not to mention requiring another card for 2D duties).

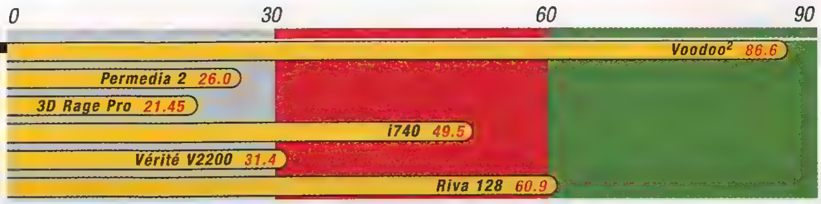
The muscle-bound **Riva 128** came in second and was the fastest of the integrated 2D/3D solutions. Impressive regardless of API, the Riva's ultra-high fill rate and fat memory-processing bus got silky-smooth frame rates a-flowin'. It's second-place finish surprised no one.

The **i740** stole third place. It was a fight between this AGP 2x part and Rendition's V2200. But when the dust settled, the i740 took out the V2200 in 11 of the 14 benchmarks. Opponents of the i740 say its split-memory architecture takes a performance hit because all texture storage and execution is done straight from system memory. But if this were the case, why did it outperform

3D TRIATHLON

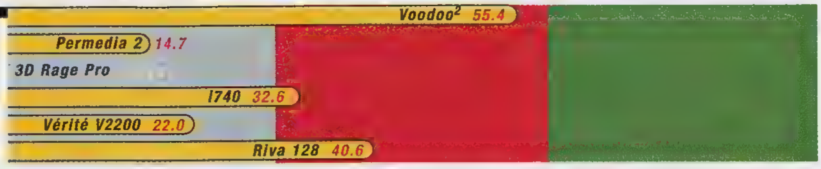
GLQuake v.98/OpenGL at 640x480

Voodoo^2 ran the original Quake's GL effects at 86fps—far short of the 100fps+ first reported, but enough to easily take first. The Riva came in 26 frames later with 60fps. The i740, with its recently released ICD, outperformed other vendor's mini-drivers and came in third.



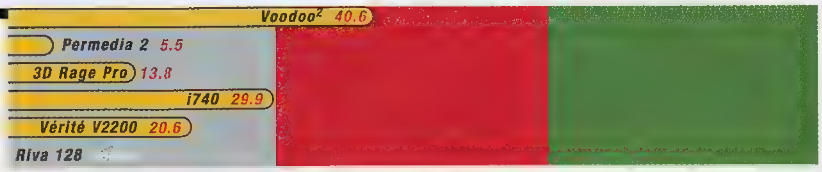
GLQuake v.98/OpenGL at 800x600

At 800x600, Voodoo^2 performance dropped down to 55fps, but was still smooth enough to win. At 40fps, only the second-place Riva provided an acceptable frame rate at this brutal resolution. The 3D Rage Pro, its mini-drivers just fresh from R&D, didn't have the training to run at this level.



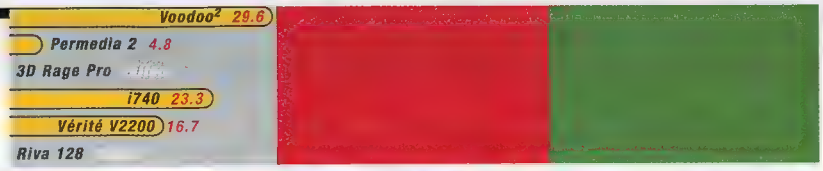
GLHexen II v1.03/OpenGL at 640x480

This Quake engine–driven fantasy romp uses higher-res textures and higher opponent polygon counts than Quake itself. Voodoo^2 took top honors with 40fps. The Riva pulled up lame and allowed the i740 to take second with 29fps. The Permedia 2 refused to leave the single-digit realm.



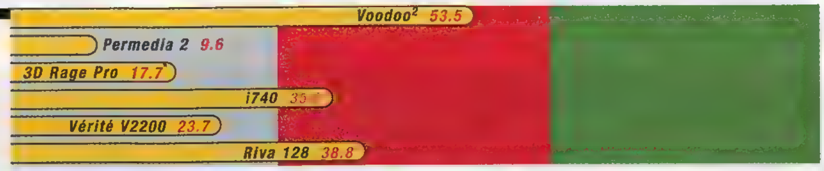
GLHexen II v1.03/OpenGL at 800x600

Stressing 3D hardware even harder, this resolution saw the Voodoo^2 and i740 maintain their first and second spots with 29.6fps and 23.3fps, respectively. The Riva again failed to run the demo file (though it should be noted the game plays smoothly at this resolution).



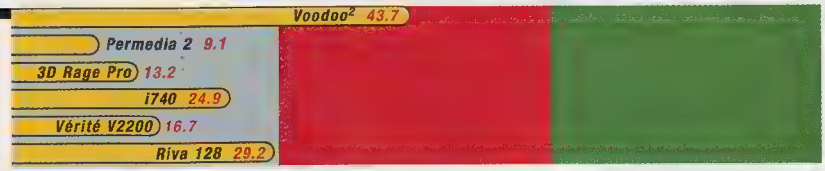
GLQuake II v3.10/OpenGL at 640x480

The latest and greatest engine from id uses more textures, complex models, alpha-transparencies, colored lighting, and particle effects than the original. Using demo2.dm2 as our benchmark file, Voodoo^2 came in first at 53.5fps. The Riva's 38fps edged past the third-place i740 by three frames.



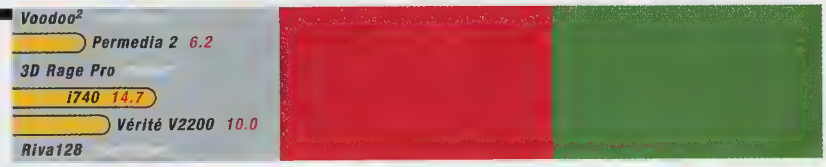
GLQuake II v3.10/OpenGL at 800x600

Quake II at this resolution can bring a chipset to its knees—but when it's running quickly, the visual experience is unmatched. Besides the Voodoo^2, which won again with a smooth 43.7fps, only the second-place Riva offered a frame rate that made the judges happy, with Intel barely finishing in the money.



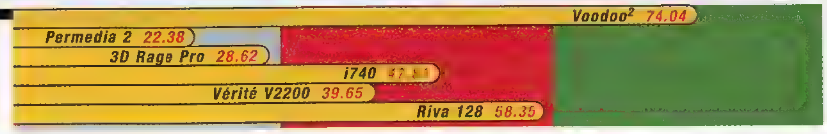
GLQuake II v3.10/OpenGL at 1024x768

Half of our competitors succumbed to high-altitude sickness at this resolution and just didn't have the memory to compete. But the i740 showed its high-res stamina, trudging through polygon molasses to post 14.7fps—hardly playable, but enough to take a first place finish here.



Average* Frame Rates at 640x480

Expect 800x600 to become the de facto playing resolution, but for now, 640x480 is standard. So, we took the frame rate each card earned in each test at that resolution and divided by six to come up with average fps performance. The numbers don't lie, folks: Do believe the Voodoo^2 hype.



† ATI gave us the first rev (v1.0.0) of beta ICD opengl32.dll for these benchmarks. These drivers are not final.
NOTE: **Can't run** denotes an intrinsic hardware limitation; **Failed** denotes the benchmark or game fails to run when it otherwise should.

the V2200's unified memory architecture? Consider it a win for AGP, too. The 3D Rage Pro and Permedia 2 limped in last. If you're looking for sheer speed, you needn't bother with these parts.

A note regarding final results: The Permedia 2's failure to run the Turok benchmark was factored into the average because the chipset also fails to run the game. The Riva 128's failure to run the GLHexen II benchmark was not factored into the average because the chipset can run the game itself.

What about Vanilla Voodoo and Dual Voodoo^2?

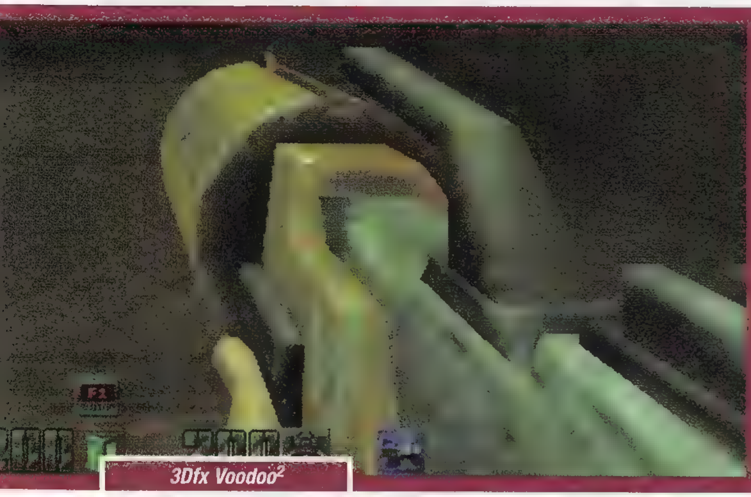
boot Net

[illegible]

3D TRIATHLON

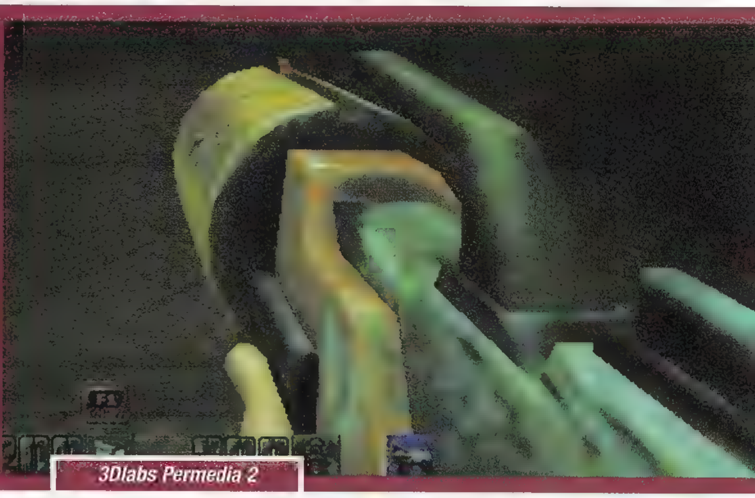
Welcome to our most controversial competition. We look for brilliant color palettes and minimal artifacts. Textures should be properly filtered, with negligible dithering and color-banding defects. Angled lines should be straight. Textures should be devoid of unsightly seams. Transparencies and alpha-blending should look exactly as coded.

The following screenshots represent each videocard's *GLQuake II* rendering quality in full-screen, 640x480 glory. Focusing on the hyperblaster, we looked closely at the relative sharpness of the edge on the orange molding, the amount of texture dithering on the top green handle, and overall color vibrancy.



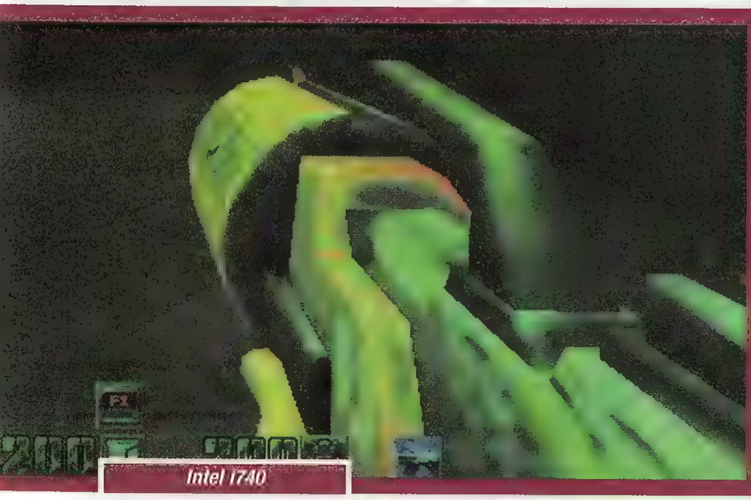
3Dfx Voodoo^2

The Voodoo^2 screenshot is almost completely devoid of dithering—but this texture smoothness comes at a price. The "over-filtering" that's used to negate dithering or banding also results in washed-out colors and soft edge angles. Are you willing to make the trade-off? Also, you may be annoyed by the horizontal line patterns that accompany 3Dfx-based visuals.



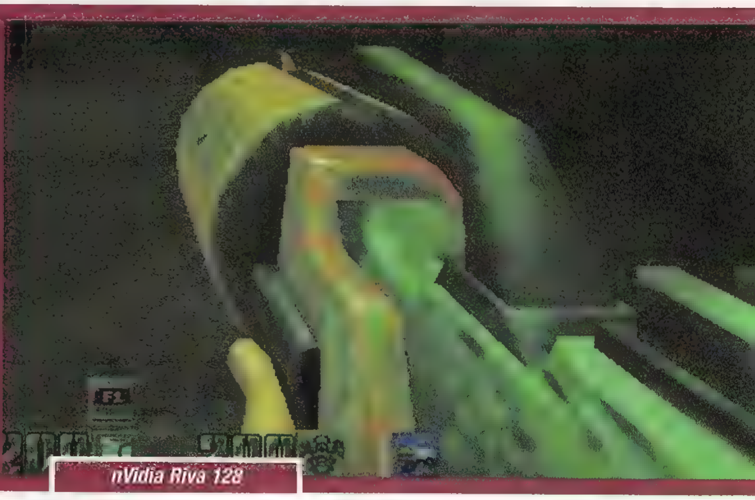
3Dlabs Permedia 2

While it suffers from the same speckled dithering problem that afflicts the Riva 128, the Permedia 2 does display good color saturation. Unfortunately, the drivers are still maturing—after playing *Quake II* for a while, textures started dropping out, and lighting effects began wreaking havoc on remaining textures. Too bad, as the rendering quality of this chipset isn't that bad.



Intel i740

Boasting high visual quality as its forte, the i740 displays excellent color saturation and sharp texture detailing (notice the sharp edge on the molding). Note the smoothly filtered gun handle and only minor banding. Very sweet. This visual quality is among the best we've ever seen.



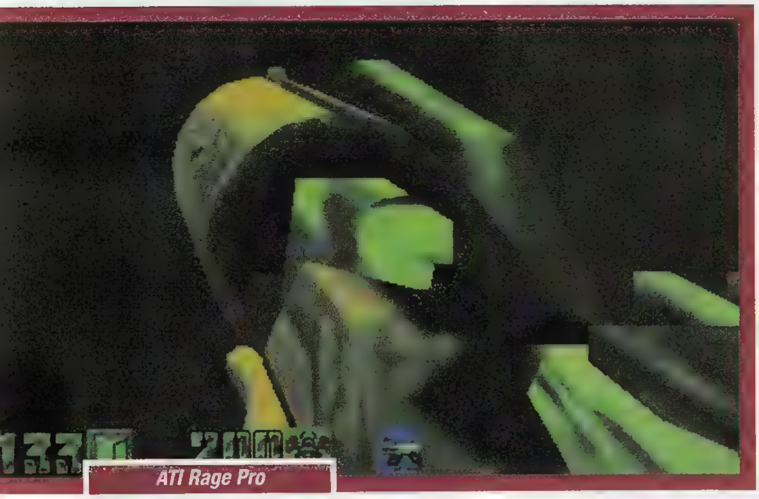
nVidia Riva 128

Look at all the dotted dithering artifacts. This defect is prevalent on everything the Riva processes. While color saturation is on par with the other non-3Dfx cards, the noticeably blocky texture filtering on the top handle—which is clearly visible in software rendering, but interpolated in every other card—must also be taken to task.

the winners

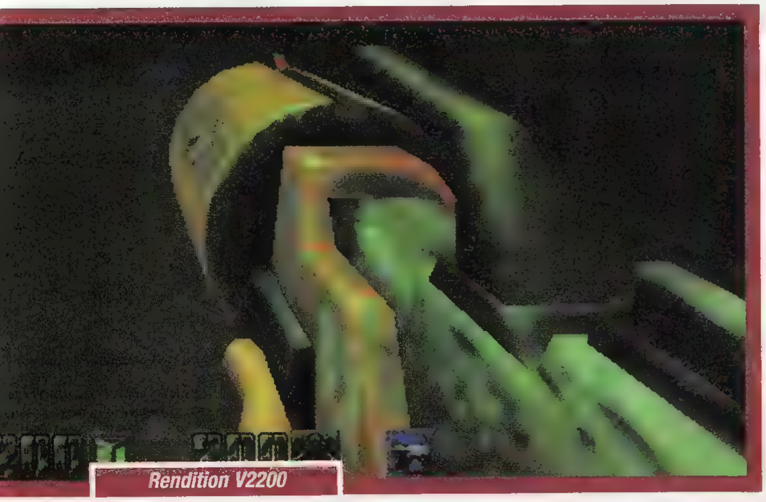
V2200 *Thanks to its rich color saturation and lack of major visual artifacts, the* ***V2200*** *took first-place, and thus wins the Visual Quality competition. The chipset strikes an elegant balance between filtering and detail, resulting in bold colors with minimal dithering and banding. It was closely followed by the* ***i740****, which boasts sharp edges, bold colors, and insignificant speckled dithering. Choosing between i740 and the V2200 was incredibly tough—both boasted excellent filtering. boot's 11 editorial and design staffers concluded that the* ***Voodoo^2*** *smoothness-for-detail trade-off is too dramatic, and awarded the chipset third place despite its almost complete lack of dithering and banding.*

visual quality



ATI Rage Pro

Here's an exclusive first look at ATI's early-beta GL mini-drivers. ATI needs to do major work—notice the missing polygons on the hyperblaster. During in-game action, walls and floors disappear. To add insult to injury, there's blatant dithering effects. This is the worst rendering of the bunch.



Rendition V2200

Rendition's solid colors and sharp detailing makes it quite a hottie. There's a hint of dithering, but it just doesn't stand out, especially when compared with the other cards' outputs. We think the smart balance between filtering and detail is the best in this field.

rendering defects

Intense scrutiny reveals a variety of rendering defects—some can be fixed by a simple driver update, while others are forever embedded in silicon. Thus is the nature of Direct3D and all the features it supports. Not every card can support every single alpha-blending or fogging mode, and the results can be less than acceptable.

For ***alpha-blended transparency effects*** *such as engine glows and explosions, a smooth transition from the texture's colors to full transparency is a must. On nVidia's Riva 128, note the dotted dithering and abrupt change from the transparent texture to the background (Figure 1). On other cards, the alpha-blending is much more subtle.*

There are two common ways to approach alpha-blending and fogging: pixel-based rendering or ***triangle/polygon-based rendering****. Figure 2 was taken from* Turok: Dinosaur Hunter *on ATI's 3D Rage Pro. Note the jagged transitions and blocky edges that signal triangle-based alpha and fog. Yuk! You should be seeing rounded edges around the explosion, with a smooth gradation between the explosion's colors. That's what you'd get with pixel-based alpha-blending and fogging, but the 3D Rage Pro can't pull this off.*

Texture seams *result from rendering flaws within silicon or drivers. You'll see cracks and black lines where different textures bump up against each other. In this screenshot (Figure 3) from the* Forsaken *demo playing on a Riva 128, black lines are clearly visible. The Riva was the only chipset in the Triathlon that exhibited this flaw.*

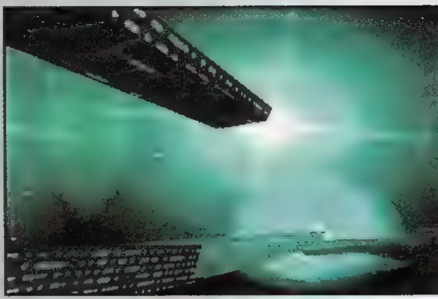


Figure 1: Alpha blending

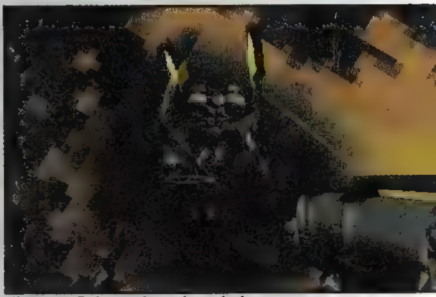


Figure 2: Polygon-based rendering

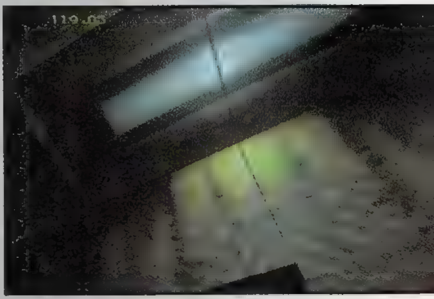


Figure 3: Texture seams

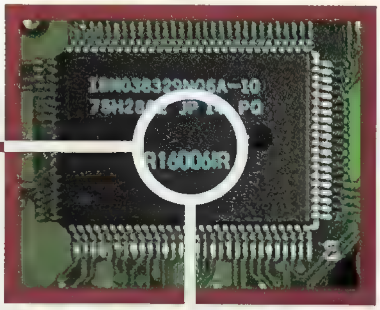
Sometimes can be influenced by what they're most familiar with. Because 3Dfx-style rendering has been the best for so long, our eyes have been trained to appreciate the architecture's idiosyncratic visuals—but we feel Voodoo^2 rendering continues a tradition of pale palettes and over-filtering. The Riva 128 is hampered by random rendering flaws, while the Permedia 2 suffers dithering and banding. The 3D Rage Pro takes last place for dropped polygons, dithering, and poor implementation of D3D effects.

Go to either the bootDisc or www.bootnet.com for the same screenshots in full-size detail

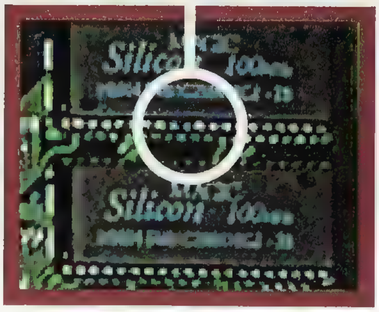
TRY IT ON THE DISC

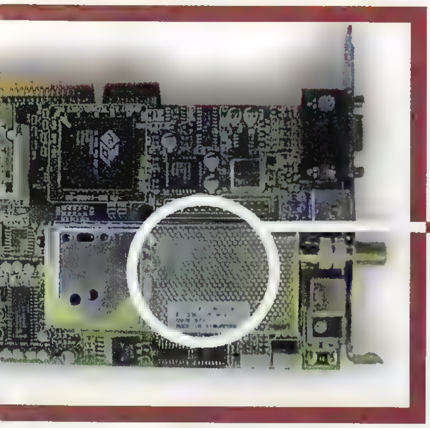
3D TRIATHLON

After pixel upon pixel of competition, it's time for the final leg of the Triathlon: features. Can you pump luscious output onto a TV screen? How about processing multiple textures in a single pass? Trilinear filtering? What about the quality and amount of local memory? Some features are implemented by the chipset manufacturer and others are spec'd by the people who make the card—so in this leg, we judged each chipset/card combo as a total package.

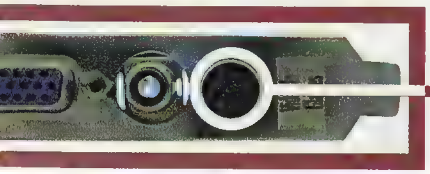


EDO DRAM and SGRAM are the two main flavors of local video memory currently available. 3Dfx's reliance on plain old EDO DRAM may come back to bite them in the ass, as the entire industry moves forward with faster SDRAM/SGRAM. Still, EDO is cheap as hell.

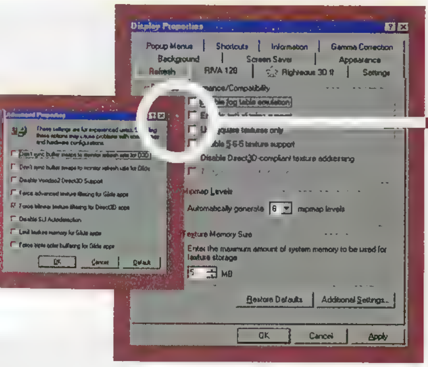




Dipping into your local TV station may not enhance 3D, but it makes you look most studly when you have Jerry Springer playing in a window while you pound away at your manifesto. While other manufacturers ask you to give up another slot for a TV tuner, ATI gives it to you in one package with its All-In-Wonder Pro. ATI also boasts excellent TV-out.



If you're into 3D shutter glasses, slide over to the Hercules' Thriller 3D and FireGL 1000 Pro, the only cards in the Triathlon that come with the proper ports.



These settings are for experienced users. ... these options may cause problems with ... and hardware configurations.

- ☐ Don't sync buffer swaps to monitor refresh rate for D3D
- ☐ Don't sync buffer swaps to monitor refresh rate for Glide
- ☐ Disable Voodoo2 Direct3D Support
- ☐ Force advanced texture filtering for Glide apps
- ☑ Force trilinear texture filtering for Direct3D apps
- ☐ Disable SLI Autodetection
- ☐ Limit texture memory for Glide apps
- ☐ Force triple color buffering for Glide apps

ance/Compatibility

- ☐ ble fog table emulation
- ☐ U square textures only
- ☐ ble 5-6-5 texture support
- Disable Direct3D-compliant texture addressing

Mipmap Levels

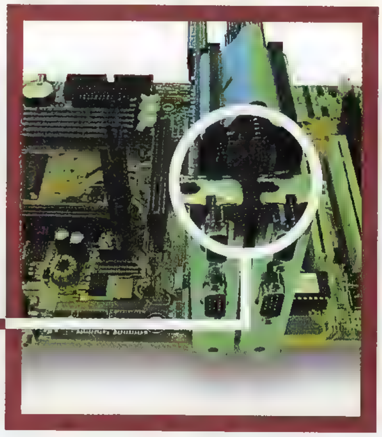
Automatically generate 6 mipmap levels

Texture Memory Size

Enter the maximum amount of system memory to be used for texture storage

5 MB

Control panel applets should let you adjust every aspect of your 3D accelerator's performance. Whether it's forcing trilinear filtering or controlling mip-mapping, no one should be forced to hack into a registry to modify settings. Thumbs up to 3Dfx and nVidia (with its most recent drivers).



Only 3Dfx is crazy enough to propose putting twin cards in a system for even more freak-nasty performance. If you want to play 800x600* Quake II *at frame rates that'll make your short-and-curlies stand on end, this is the only way to go.

feature-set winner

TV-out may sound like a check-box item, but done wrong, it sullies the overall product. The Thriller 3D, for example, has lackluster TV output thanks to its BrookTree TV decoder chip, while ATI's TV input/output is simply superb.

The Voodoo^2 is the only chipset to do multitexturing in a single pass, but its 16-bit maximum Z-buffer puts it at a disadvantage, especially with game developers working on 24-bit Z-buffer titles. The only cards with 24-bit Z-buffer compliance are the Vérité V2200 and the Permedia 2.

Driver implementation is also important. Do you just run with your chipmaker's reference drivers or do you add special features? Creative Labs (Voodoo^2) and Hercules (V2200) ship stock reference drivers with no perks. But Diamond's Monster 3D II (reviewed on page 72) adds an overclocking slider.

AGP 2x with sidebands should be your baseline—putting all chipsets save the 3D Rage Pro and i740 out of the running. Direct3D 6 features, such as bump-mapping and anisotropic filtering, should also be present and accounted for. The only card to support trilinear filtering without a major performance hit is the Voodoo^2.

First place in the Features competition goes to the 3D Rage Pro–fueled ***ATI All-In-Wonder Pro****. This card offers the awesome TV tuner (with video capture), the best TV-out available, AGP 2x/Execute mode compliance, and the highest maximum double-buffered 3D resolution in the Triathlon.*

Second place goes to the V2200-fueled ***Thriller 3D****. This card offers support for TV-out and shutter glasses, and boasts a high maximum double-buffered 3D resolution. But perhaps most importantly, the V2200 offers a 24-bit Z-buffer.*

The Voodoo2-fueled ***3D Blaster*** *comes in third with the highest local memory count, all 3D features enabled, and dual SLI-readiness. Even though Creative Labs decided to go with 3Dfx reference drivers, the 3D Blaster's control panel features are still some of the best available. This card would have come in second if it offered a higher maximum resolution and Z-buffer bit-depth, used faster memory and offered 2D capabilities. If you buy Voodoo^2, get a Matrox Millennium II or Number Nine Revolution 3D for the best 2D performance.*

The remaining cards in the Triathlon offer a mixed bag of extra features. None particularly outshines the other, so the judges ruled them all fourth place in a photo-finish.

features

	3D Blaster Voodoo^2	FireGL 1000 Pro	All-In-Wonder Pro	StarFighter	Thriller 3D	Viper V330
INTERFACE						
Chipset	Voodoo^2	Permedia 2	3D Rage Pro	i740	V2200	Riva 128
Bus supported	PCI	PCI/AGP	PCI/AGP	AGP*	PCI/AGP	AGP
AGP specification	N/A	1x/Execute	2x/Execute	2x/Execute	1x/DMA	1x/DMA**
Support for SLI/ dual card modes	YES	NO	NO	NO	NO	NO
3D SPECIFICATIONS						
Size of processing path	192 bits***	64 bits	64 bits	64 bits	64 bits	128 bits
Max 3D resolution double-buffered	800x600	1024x768	1280x1024†	1024x768	1024x768	960x720
Type of memory architecture	Split	Unified	Unified	Split	Unified	Unified
Maximum Z-buffer bit-depth	16-bit	24-bit	16-bit	16-bit	24-bit	16-bit
Local memory	12MB	8MB	8MB	8MB	8MB	4MB
Type of memory used	EDO DRAM	SGRAM	SGRAM	SGRAM	SGRAM	SGRAM
RAMDAC	135MHz	230MHz	230MHz	220MHz	230MHz	230MHz
RAM field upgradable	NO	NO	YES	YES	NO	NO
TV-output	NO	NO	YES	NO	YES	NO
Stereographic shutter glasses port	NO	YES	NO	NO	YES	NO
3D in a window	NO	YES	YES	YES	YES	YES
3D FEATURE SET						
Triangle setup engine	YES	YES	YES	YES	YES	YES
Trilinear filtering	YES	YES	YES	NO	YES	YES
Edge anti-aliasing	YES	NO	YES	YES	YES	NO
Single-pass Multitexturing	YES	NO	NO	NO	NO	NO
APIs supported	D3D/GL/Glide	D3D/GL	D3D	D3D/GL	D3D/GL/RRedline/ Speedy3D	D3D/GL
GL drivers type	mini	ICD	ICD†††	ICD††	ICD†††	ICD†††

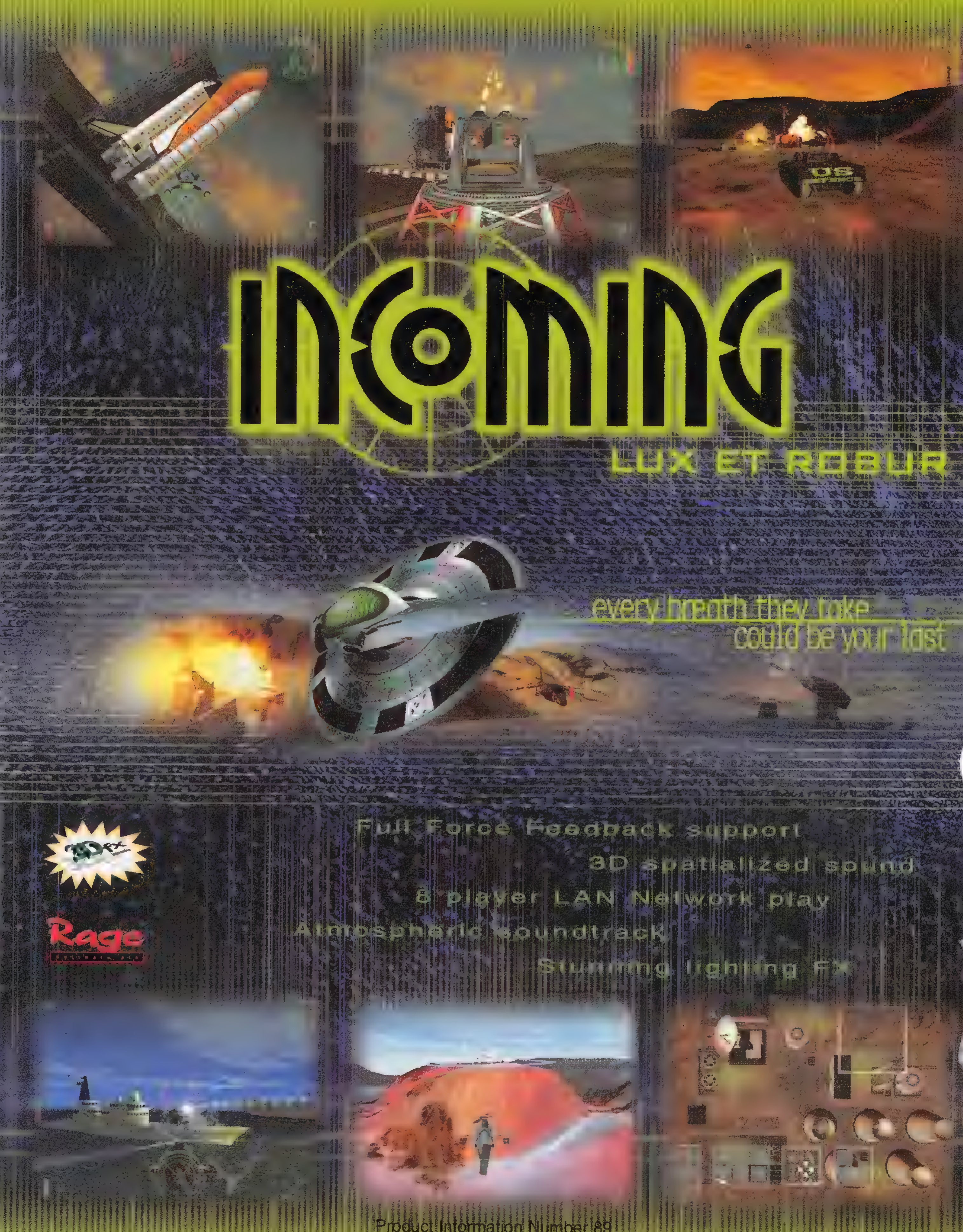
* Real3D plans a PCI part using an AGP-to-PCI bridge chip, but Intel's official company line is that i740 is an AGP part only.
** nVidia performs direct-from-memory execution of textures, regardless of bus.
*** 64 bits per fx2 chip (three total per Voodoo^2 board).
† This is with an 8MB AGP board, where system memory is used for texture storage. Without AGP, you're limited to 1024x768.
†† Will be available soon; D3D to GL wrapper currently used.
††† GL drivers currently available as public beta.

the triathlon winner

boot has yet to see the perfect 3D accelerator. The fastest chipset doesn't boast the best visual quality, the prettiest chipset doesn't offer the speediest frame rates, and the most versatile card excels in neither speed nor rendering quality. Yet a single competitor must win the Triathlon. To this end, we're awarding three points for every first-place prize, two points for every second-place prize, and one point for every third-place prize. This formula places Voodoo^2 and the V2200 in a tie for first with five points. But since Voodoo^2 placed in each of the three events—unlike the V2200, which just barely missed third place in the Speed competition—we're awarding 3Dfx's juggernaut the tie-breaker and naming it the overall Triathlon winner. b

MEDAL COUNT

	Voodoo^2	V2200	i740	Riva 128	3D Rage Pro	Permedia 2
Gold	1	1			1	
Silver		1	1	1		
Bronze	2		1			



INCOMING

LUX ET ROBUR

every breath they take
could be your last

Full Force Feedback support

3D spatialized sound

8 player LAN Network play

Atmospheric soundtrack

Stunning lighting FX

Rage

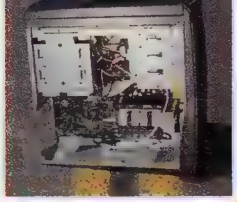
Product Information Number 89

SPEED TRAP

400MHz Muscle Cars Cited for *Excessive Velocity*

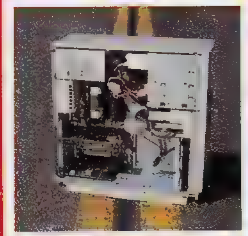
BY JON PHILLIPS

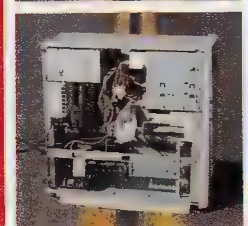
When three hot new systems roared onto the PC turnpike, we knew we had to collar the desperadoes and pull 'em into our motor pool for a peek under the hood. We found high-performance parts, as expected, but nothing prepared us for the screaming fast lap times these babies clocked on the bootTrack. Each impounded vehicle contains the same engine/carburetor combo—a 400MHz Pentium II teamed up with Intel's 440BX core-logic chipset. The 440BX increases your memory-bus speed limit from 66MHz to 100MHz. That's right, Gomer, each of these machines is packed with 100MHz SDRAM, 64MB to be exact. So prepare yourself for the fastest benchmarks you've ever seen—and make sure to check the 440BX owner's manual on page 56.



Road Runner

PHOTOGRAPHY BY AARON LAUER





NEC Direction SPB 400

Burning rubber on the 100MHz turnpike

boot KICK ASS! PRODUCT

Smokey might want to check for a nitrous kit on the SPB 400, because this hot rod races at nearly illegal levels of Pure PC Power. Clocking a bombastic bootMark of 192, the SPB 400 shatters the previous bootMark record by 35 points. What a difference two months make. The old record was posted by the SPB 400's little brother, a 333MHz mid-size sedan that was still chugging down Route 66—the 66MHz system bus, that is. But now Intel's 440BX core-logic chipset paves a new 100MHz fast lane for PC grease monkeys, and the speed limit increase is manifest across-the-board in the SPB 400's benchmark results.

MMX performance: 166. Boom! The fastest ever.

CPU/Disk performance: 78. Boo-yah! The fastest ever.

DirectX gaming performance: 180. Yee-haw! The fastest ever.

Well, the fastest ever for about a day. The SPB 400 did in fact own a number of land-speed records before the 400MHz Micron Millennia Xi cruised into town, posting even faster numbers in the key system-taxing benchmarks. Still, the SPB 400 wasn't beaten by much and is a better value for the money.

Key to any BX-fueled machine is its high-speed memory, and the SPB 400 has 64MB of 100MHz SDRAM sitting on its Intel Seattle ATX motherboard. The DIMM is exposed and pluckable—like a straight-six sitting in a V-12 engine cavity. In fact, like all Direction series machines we've seen, the SPB 400's interior design is a paragon of easy access. Other than the Riva 128–powered Diamond Viper V330 sitting in the AGP slot and the X2 WinModem sitting in the bottom ISA slot, the m'board is an open book. You get four free PCI slots, unless you go for the Voodoo² option (for another $200).

Faced with handling 3D duties on its own, the Viper V330 posted 70fps on the ForsakenMark—a nice score, but nowhere near the rate achieved by the Micron's 400MHz CPU/Voodoo² combo. The SPB 400's videocard was using nVidia reference drivers instead of Diamond's own software. The nVidia drivers give you better control panel options, but for some reason we were denied 2D resolutions higher than 1024x768. The SPB 400 also scored 416 on the driver-sensitive SysMark32 test—13 points less than what was mustered by the 333MHz Direction machine.

Storage I/O performance was a mixed bag. Spinning at 7,200rpm, the 9.1GB Seagate Medalist Ultra DMA hard drive posted 6.34MB/sec throughput, the best we've ever seen from an NEC machine. But on the atrocious flipside, the "32x" NEC A810SM CD-ROM drive posted 2,792K/sec. That's about 900K less than what was achieved by the very same drive in the 333MHz Direction. So what happened? A firmware revision? Changes in the core-logic chipset's EIDE interface? Did they ship us a random lemon? We may never know, but the fact remains we ran the CD-Tach test 16 times and couldn't achieve a higher score.

Like any cherry road racer, the SPB 400 comes stock with a worthy sound system. The Altec Lansing subwoofer/satellite combo doesn't have ultimate volume, but will thump rocket blasts and audio CDs unless you're absolutely intent on pissing off your neighbors. The Crystal PCI sound chip supports DirectSound and DirectSound3D, and is a major step up from the Yamaha OPL3 that previously sat on Direction series motherboards.

Throw in the oh-so-familiar Hitachi CRT-based 19-inch monitor, and you have one of the best values in the direct-order car lot. Kind of like buying a Porsche for the price of a Camaro.

PLENTY OF COOLANT, BUT THEY PUT A GOVERNOR ON THE MOTOR

The Pentium II is cooled by three fans and a wicked aluminum heatsink. Unfortunately, you may never get the chance to test the resolve of this awesome cooling system. With neither soft jumpers in the BIOS nor hard jumpers on the motherboard, the machine auto-detects the CPU to keep it locked in at 400MHz.

SPI
SPARKLE POWER INTL. LTD.
SWITCHING POWER SUPPLY
MODEL NO: FSP235-60GT

under the hood

THE BRAINS

CPU	400MHz Pentium II Deschutes
L2 Cache	512K BSRAM (internal)
RAM	64MB 100MHz SDRAM
Motherboard	Intel Seattle 440BX, ATX formfactor

THE BRAWN

Video	Diamond Viper V330 4MB (Riva 128 chipset)
Hard Drive	Seagate Medalist Ultra DMA 9.1GB
CD-ROM	32x NEC A810SM
Expansion	One AGP, three PCI, one ISA, one shared PCI/ISA
Fax/Modem	X2 WinModem
I/O Ports	Two USB, two serial, one parallel, one gameport

THE BEAUTY

Display	NEC C900, 19-inch, 0.27mm dot pitch, 1600x1200@75Hz
Sound	Crystal SoundFusion PCI (soldered on motherboard)
Speakers	Altec Lansing ACS410s with ACS251 subwoofer
Other	Zip drive, Microsoft Intellimouse

EXPANSION MAP

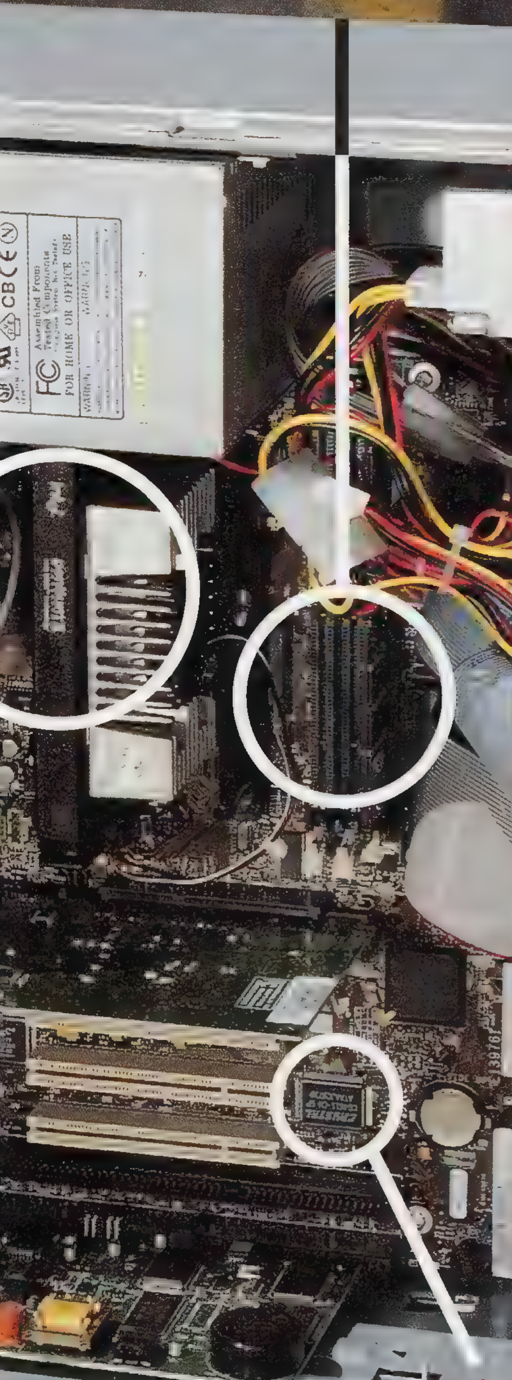
[illegible]	
PCI	Free
PCI	Free
PCI	Free
PCI	Free/Shared
ISA	Free/Shared
ISA	X2 Modem

THE BUNDLE Windows 95 I MS Home Essentials

boot	down
:56	:06

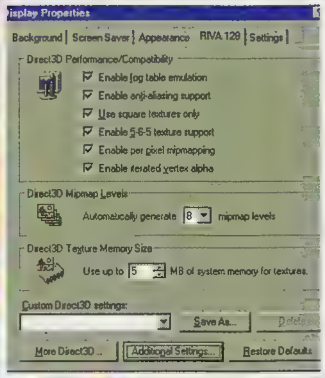
IT'S A BX-INJECTED FUNNY CAR!

You get two open DIMM slots to top out at 384MB of memory. Just make sure you fuel your 440BX with 100MHz SDRAM as mandated by the PC100 spec. Anything else and you'll just be spinning your wheels.



MORE CONTROLS THAN THE COCKPIT OF A 747

nVidia Riva 128 reference drivers give you a handy control panel for custom tweaking specific 3D features. Hack away, Elroy!



Direct3D Performance/Compatibility
☑ Enable fog table emulation
☑ Enable anti-aliasing support
☑ Use square textures only
☑ Enable 5-6-5 texture support
☑ Enable per pixel mipmapping
☑ Enable iterated vertex alpha

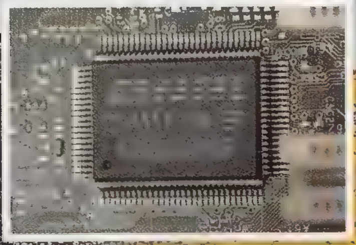
Direct3D Mipmap Levels
Automatically generate 8 mipmap levels

Direct3D Texture Memory Size
Use up to 5 MB of system memory for textures.

Custom Direct3D settings:

IT'S ALL IN THE FINE DETAILING

The Crystal SoundFusion PCI chip soldered to the motherboard doesn't offer the best sound quality in the PCI audio camp, but it's better than any motherboard-bound silicon that's riding the ISA bus.



city of boot

NOTICE TO APPEAR

NEC-SPB 400

DATE May 1998	TIME 9:00 AM	DAY OF THE WEEK M [✓ T] W TH F S SU
VEHICLE MAKE NEC		MODEL Direction SPB 400

VIOLATIONS:

CPU/MOTHERBOARD bootMark	+ 192
WIN 95 APPS SYSmark32	416
DIRECT3D ForsakenMark / composite	70
HARD DRIVE Adaptec Threadmark v2.0	6.34 MB/sec
CD-ROM CD Tach/Pro v1.65	2792 K/sec
WIN95 VIDEO ActiveMovie	100 % played
DOS GAMING Quake v1.4	37.3 fps
DIRECTX GAMING MDK Perftest v1.4	+ 180
MMX PROCESSING DeBabelizer Pro	166 sec
CPU/DISK Microsoft Visual C++ compile	78 MB/sec

VEHICLE DESCRIPTION: The SPB 400 packs power-to-burn for serious PC road racers. It's not the fastest car, but it boasts the best performance-to-price ratio.

MERIT POINTS:	INFRACTIONS:
Fastest CPU, core-logic chipset and memory available	Despicable CD-ROM scores
Screaming benchmarks across-the-board	Drivers couldn't swing high-res 2D
Improved hard drive performance	
PCI audio and boomin' speakers	
Low price for performance category	

PRICE $2,898 (includes 19" monitor)
COMPANY NEC
PHONE 888.863.2669
URL www.NEC.com

boot verdict 9

A complete breakdown of benchmark results is available on the *bootNet.* Point your browser to www.bootnet.com

Micron Millennia Xi

Unparalleled power—at a pretentious price

Micron must have loaded the Xi with jet fuel, because this machine ran through the benchmarks like some kind of rocket car. The Xi set seven new desktop-system bootLab records, besting previous high scores in every category save Win95 apps and CD-ROM performance. Mind you, some of the individual victories were by extremely slim margins, but that's what makes the racing circuit so damn exciting.

Scoring 192.1 on the bootMark, the Xi beat the NEC Direction SPB 400 by just one-tenth of a point. The Xi also snaked bragging rights from the SPB 400 in DirectX gaming (by one point), CPU/disk performance (by one second), DOS gaming (by 4.2fps), and MMX performance (by 14 seconds). The Xi widened the margin with a bodacious 110.81fps on the ForsakenMark. That's 40.81fps faster than the NEC machine, but what do you expect from a Voodoo^2/400MHz CPU combo?

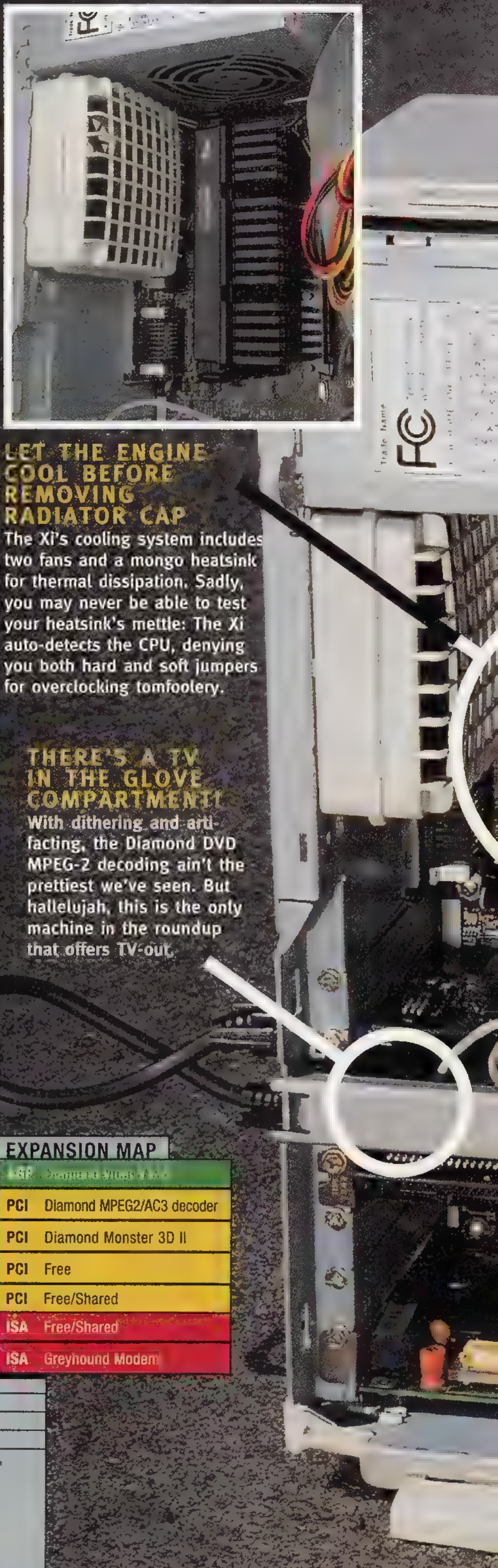
The Voodoo^2 graphics come courtesy of Diamond's 12MB Monster 3D II. Micron must have wheedled an evaluation sample of the board for this review, because Diamond told us no 12MB units were available for our Voodoo^2 roundup on page 72. Whatever. The Xi will with ship the 12MB board, and we're glad we got a chance to see it in action. Zipping through *GLQuake II*, the Voodoo^2 cranked 45.8fps at 800x600, and 66.3fps at 640x480. That 640x480 score is about 13 frames faster than what we pulled from a 12MB Creative Labs card teamed with a 300MHz/66MHz system, so you can bet your pink slip that the faster CPU and system bus do indeed turbocharge 3D gaming.

After polygon time trials, we turned to the storage I/O and clocked a ThreadMark score that knocked our jaws open. The IBM Deskstar Ultra DMA hard drive shredded 7.14MB/sec, a mark that simply rips for a non-SCSI device. Like the NEC machine, the Xi posted abominable CD-ROM read times. It's possible that Toshiba's new SD-M1102 second-gen DVD-ROM drive isn't ready for prime time, but 1,486K/sec on the CD-Tach is plain laughable. For a comparison, dig the Compaq Presario 4880 on the next page. It tached 2,067K/sec with a second-gen Hitachi DVD-ROM drive.

The Xi's DVD movie playback was also disappointing. The Diamond decoder card produced blatant artifacts and dithering, and couldn't measure up to the Presario 4880's software decoding. With 400MHz of processing power sitting idle, you have to wonder why Micron went with hardware decoding. But at least you get the Video-Out jacks on the back of the decoder card and Diamond's DVD console does include a nifty frame-by-frame advance button.

The Advent AV390 subwoofer/satellite combo sounds just a tad small compared with the bootWorthy Cambridge SoundWorks MicroWorks that used to ship with Millennia systems. The MicroWorks thump to a 10Hz–20kHz frequency response, while the Advents muster just 40Hz–20kHz. Will you ever need the ultra-deep lows? Let's just say if you're cruising Valencia on a Friday night, bumpin' butt-booty bass like you just don't give a damn, you'd attract more attention with the MicroWorks.

The Xi uses the same Intel Seattle ATX motherboard as the NEC Direction SPB 400, complete with the Crystal SoundFusion PCI chip soldered onboard. And like the SPB 400, you also get 64MB 100MHz SDRAM, a Zip drive, and a monitor with that familiar and kick-ass 19-inch Hitachi CRT. But the Xi costs about $750 more than an SPB 400 with a Voodoo^2 upgrade, and that's too much to pay for a little extra horsepower. We love the performance but hate the price.



LET THE ENGINE COOL BEFORE REMOVING RADIATOR CAP
The Xi's cooling system includes two fans and a mongo heatsink for thermal dissipation. Sadly, you may never be able to test your heatsink's mettle: The Xi auto-detects the CPU, denying you both hard and soft jumpers for overclocking tomfoolery.

THERE'S A TV IN THE GLOVE COMPARTMENT!
With dithering and artifacting, the Diamond DVD MPEG-2 decoding ain't the prettiest we've seen. But hallelujah, this is the only machine in the roundup that offers TV-out.

under the hood

THE BRAINS

CPU	400MHz Pentium II Deschutes
L2 Cache	512K internal SBRAM
RAM	64MB 100MHz SDRAM
Motherboard	Intel Seattle 440BX, ATX formfactor

THE BRAWN

Video	Diamond Viper V330 AGP (4MB nVida Riva 128), Diamond Monster 3D II (12MB Voodoo^2), Diamond DVD MPEG-2/AC3 Decoder
Hard Drive	IBM Deskstar 10.1GB Ultra DMA
DVD-ROM	Toshiba SD-M1102
Expansion	One AGP, three PCI, one ISA, one shared PCI/ISA
Fax/Modem	3COM Greyhound 56Kbps X2
I/O Ports	Two USB, two serial, one parallel, one gameport, video-out, S-video-out

THE BEAUTY

Display	Hitachi 19-inch CM751, 0.26mm dot pitch, 1600x1200@75Hz
Sound	Crystal SoundFusion PCI (soldered on motherboard)
Speakers	Advent AV390
Other	Zip drive, Microsoft Intellimouse

EXPANSION MAP

AGP	[illegible]
PCI	Diamond MPEG2/AC3 decoder
PCI	Diamond Monster 3D II
PCI	Free
PCI	Free/Shared
ISA	Free/Shared
ISA	Greyhound Modem

THE BUNDLE Microsoft Windows 95 I Microsoft Office 97 Small Business Edition

boot	down
:32	:06

TOUGH TRANSFERS DEMAND A STURDY DRIVETRAIN

With 10GB of storage space and a 7,200rpm spindle speed, the IBM Deskstar Ultra DMA is one of the best hard drives we've ever reviewed. Can your drive beat 7.14MB/sec throughput and 26% CPU utilization? Well, can it?

A V-12 FOR SPEED TO SPARE

With even more demanding, texture-rich games on the horizon, you're going to appreciate the 12MB Voodoo². You simply can't argue with the fastest Direct3D and OpenGL gaming scores we've ever seen in a consumer desktop system. Too bad 2D duties are handled by the 4MB Diamond Viper V330 and a steel strut blocks card access.

city of boot

NOTICE TO APPEAR M-MXI

DATE May 1998	TIME 9:00 AM	DAY OF THE WEEK M [✓ T] W TH F S SU
VEHICLE MAKE Micron		MODEL Millennia Xi

VIOLATIONS:

CPU/MOTHERBOARD bootMark	+ 192.1
WIN 95 APPS SYSmark32	427
DIRECT3D ForsakenMark / composite	+ 110.81
HARD DRIVE Adaptec Threadmark v2.0	7.14 MB/sec
DVD-ROM CD Tach/Pro v1.65	1486 K/sec
WIN95 VIDEO ActiveMovie	100 % played
DOS GAMING Quake v1.4	41.5+ fps
DIRECTX GAMING MDK Perftest v1.4	+ 179
MMX PROCESSING DeBabelizer Pro	152 sec
CPU/DISK Microsoft Visual C++ compile	77 MB/sec

VEHICLE DESCRIPTION: There's not a faster machine on the turnpike—but this road-hog is also a cash guzzler.

MERIT POINTS:	INFRACTIONS:
Fastest CPU, core-logic chipset, and memory available	High price
Record-setting power—everywhere	Bad MPEG-2 decoding
Incredible hard drive	Awful CD-ROM drive read times
12MB Voodoo²	
PCI sound	
TV-out	
DVD-ROM drive	

PRICE $3,850 (includes 19" monitor)

COMPANY Micron

PHONE 888.634.8799

URL www.micron.com

boot verdict 8

A complete breakdown of benchmark results is available on the *bootNet*. Point your browser to www.bootnet.com

Compaq **Presario** 4880

Some punk poured sugar in the gas tank

The Presario 4880 is like some kind of strange French car with ornate detailing, an unconventional engine design, and safety features that tax performance. Sure, it looks more or less like a computer on the outside, but you might not recognize much once you get under the hood. Be prepared to break open your owner's manual, because with the benchmarks this machine posted, you'll definitely want to get your hands greasy.

In our three-car drag race, the 4880 placed last in seven benchmark categories. Dig its bootMark of 185.6—the other two machines each hit nearly identical scores that were five points higher. So what gives? Barring any deep-seated engineering flaws, we have to blame the Active Desktop, care of "Compaq-enhanced" *Internet Explorer 4.0*. In addition to browser-style folder navigation, Active Desktop places a little entertainment console on your screen to give you faster access to online content from Disney, MSNBC, and America Online.

boot condemns this newbie handholding, the amount of power it saps, and the difficulty with which it is removed from the system. Chances are little Timmy, unfamiliar with the bootWay, will be staring at the enervating and useless console through the end of the millennium.

Video-subsystem performance left us yearning, too. The 3D Rage Pro AGP had neither the 2D horsepower to fuel a good score in SYSmark32, nor the 3D fuel-injection to muster a fast frame rate on the ForsakenMark. And check out the 28.3fps on unaccelerated *Quake*—we've seen higher scores from systems with 300MHz CPUs. The real travesty, however, is that the video chipset is soldered to the motherboard, denying you an AGP slot for a future upgrade. The whole interior, in fact, is a miasma of baffling design decisions.

Open up the case and you'll see just a small patch of motherboard green. That's because a riser board bracket blocks access to the drivetrain. Pull off that bracket (it contains the PCI and ISA slots) and you'll see a dreaded LPX motherboard, which by definition defies replacement. CPU cooling is dubious, with a single fan pointing at a large honeycomb-style heatsink. A fan attached to the power supply blows wind too, but it's so far removed from the engine block, you better not count on it or it'll break your heart.

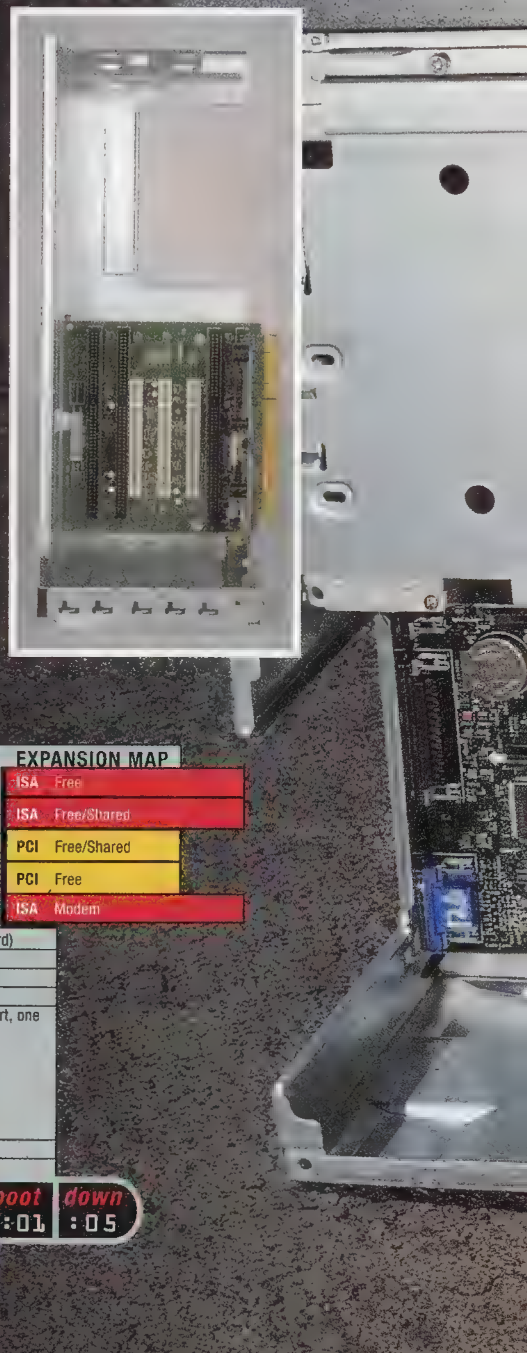
The Quantum T-Rex hard drive—entombed in a metal holding pen away from the other storage drives—posted 5.61MB/sec on the ThreadMark. Don't expect this unexciting score to remain consistent for all 4880s. Compaq "multisources" its hard drives and only promises you an 8GB EIDE device from an unnamed manufacturer. The DVD-ROM drive is also multisourced, but we peaked into the Device Manager and found the familiar Hitachi GD-2000. This drive posted a fair CD Tach score, and its software DVD MPEG-2 decoding was good.

Unfortunately, the multimedia experience dips again as you make your way to the sound system. The soldered-on ESS 1869 audio chip does indeed ride the PCI bus, but doesn't support any newfangled APIs—or even hardware wavetable! The JBL ported bass speakers (which come attached to an optional 17-inch monitor) lack volume and sound like the ghost of $29 boom-box.

Don't be fooled, bootReader, the 4880 sells itself as a bad-ass concept car, but inside ticks the heart of a clunky Citroen.

SHOULDN'T THIS PART BE BOLTED DOWN?

With so much silicon soldered to the motherboard, your expansion slots only play host to a lonely K56flex modem. All the slot-car action is tucked into a funky riser board that attaches to the mother board via a long connector.



EXPANSION MAP

ISA	Free
ISA	Free/Shared
PCI	Free/Shared
PCI	Free
ISA	Modem

under the hood

THE BRAINS

CPU	400MHz Pentium II Deschutes
L2 Cache	512K BSRAM (internal)
RAM	64MB 100MHz SDRAM (384MB max)
Motherboard	Compaq (proprietary), 440BX, LPX formfactor

THE BRAWN

Video	ATI 3D Rage Pro 4MB (soldered on motherboard)
Hard Drive	Quantum T-Rex 8GB EIDE
DVD-ROM	Hitachi GD-2000 (software decoding)
Fax/Modem	K56flex modem
I/O Ports	Two USB, one serial, one parallel, one gameport, one video-in, one stereo audio-in

THE BEAUTY

Display	Compaq Presario FX700, 0.28mm dot pitch, 1024x768@75Hz
Sound	ESS 1869 PCI (soldered on motherboard)
Speakers	JBL Pro Speakers with Ported Bass

THE BUNDLE Windows 95 | Colordesk | Intel Video Capture Utility | Microsoft Works 4.5 | Quicken 98 | Video Phone Send & Receive | IE 4.0 | Incoming AGP | iPhoto Express | MS Bookshelf 98 | Microsoft Encarta 98 | Microsoft Money 98 | MotoRacer MMX | Wing Commander DVD

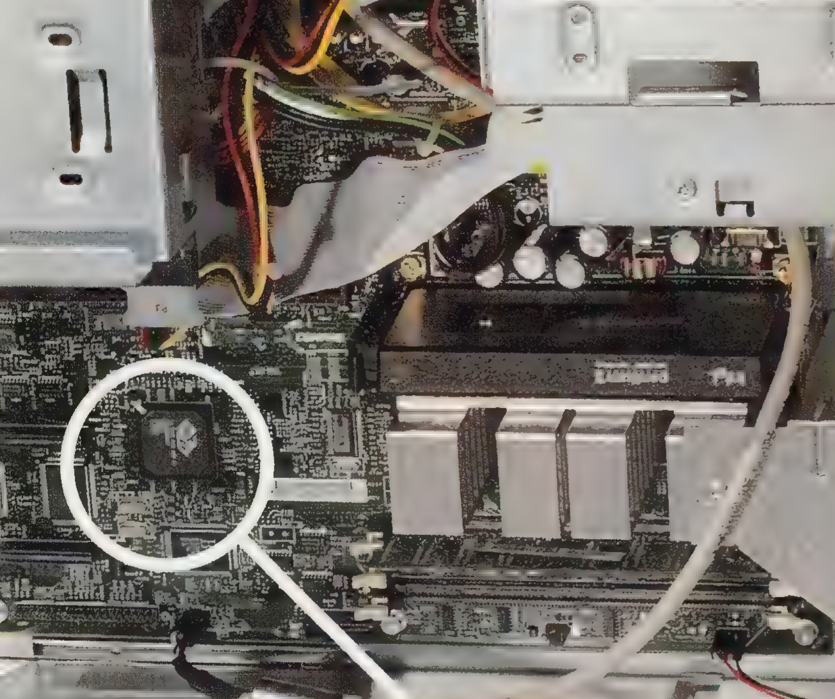
boot	*down*
1:01	:05

WHO THE HELL CHANGED MY PRESETS?

The top of the tower provides not only video-in jacks, but also application launchers, DVD/CD/volume controls, and a sleep-mode button.

EVERY LUXURY CAR NEEDS A GOOD MAKEUP MIRROR

Boasting a 0.28mm dot pitch and a maximum refresh rate of 75Hz at 1024x768, the $700 Compaq monitor—17 inches and full of reflective glare—should be avoided. The wimpy speakers will disappoint you, too.



city of boot
NOTICE TO APPEAR
CP-4880

DATE MAY 1998	TIME 9:00 AM	DAY OF THE WEEK M [✓ T] W TH F S SU
VEHICLE MAKE COMPAQ		MODEL PRESARIO 4880

VIOLATIONS:

CPU/MOTHERBOARD bootMark	185.6
WIN 95 APPS SYSmark32	324
DIRECT3D ForsakenMark / composite	50.27
HARD DRIVE Adaptec Threadmark v2.0	5.61 MB/sec
CD-ROM CD Tach/Pro v1.65	2067 K/sec
WIN95 VIDEO ActiveMovie	100 % played
DOS GAMING Quake v1.4	28.3 fps
DIRECTX GAMING MDK Perftest v1.4	156
MMX PROCESSING DeBabelizer Pro	160 sec
CPU/DISK Microsoft Visual C++ compile	87 MB/sec

VEHICLE DESCRIPTION: THIS 400MHZ SYSTEM DOESN'T OFFER ANYTHING TO POWERMONGERS—AND COSTS MORE THAN ANYONE SHOULD HAVE TO PAY FOR THE COMPONENTS INSIDE.

MERIT POINTS:	INFRACTIONS:
GOOD SOFTWARE MPEG-2 DECODING	POOR CPU/MEMORY PERFORMANCE
NICE SOFTWARE BUNDLE	POOR BENCHMARKS ACROSS-THE-BOARD
VIDEO-IN ON FRONT PANEL	SOLDERED-ON AGP VIDEO
	VEXING CASE DESIGN
	HIGH PRICE

PRICE $2,600; $3,300 W/MONITOR
COMPANY COMPAQ
PHONE 800.345.1518
URL WWW.COMPAQ.COM

boot verdict 5

A complete breakdown of benchmark results is available on the *bootNet*. Point your browser to www.bootnet.com

ATi 3D
3D RAGE PRO AGP 2X
TAIWAN

SORRY, WE DON'T ACCEPT TRADE-INS

Get nice and comfy with that soldered-on 3D Rage Pro processor, because without an AGP slot, you'll never get a chance to upgrade your AGP device. And forget about upgrading to a motherboard with an AGP slot: LPX motherboards are proprietary hardware and defy easy replacement.

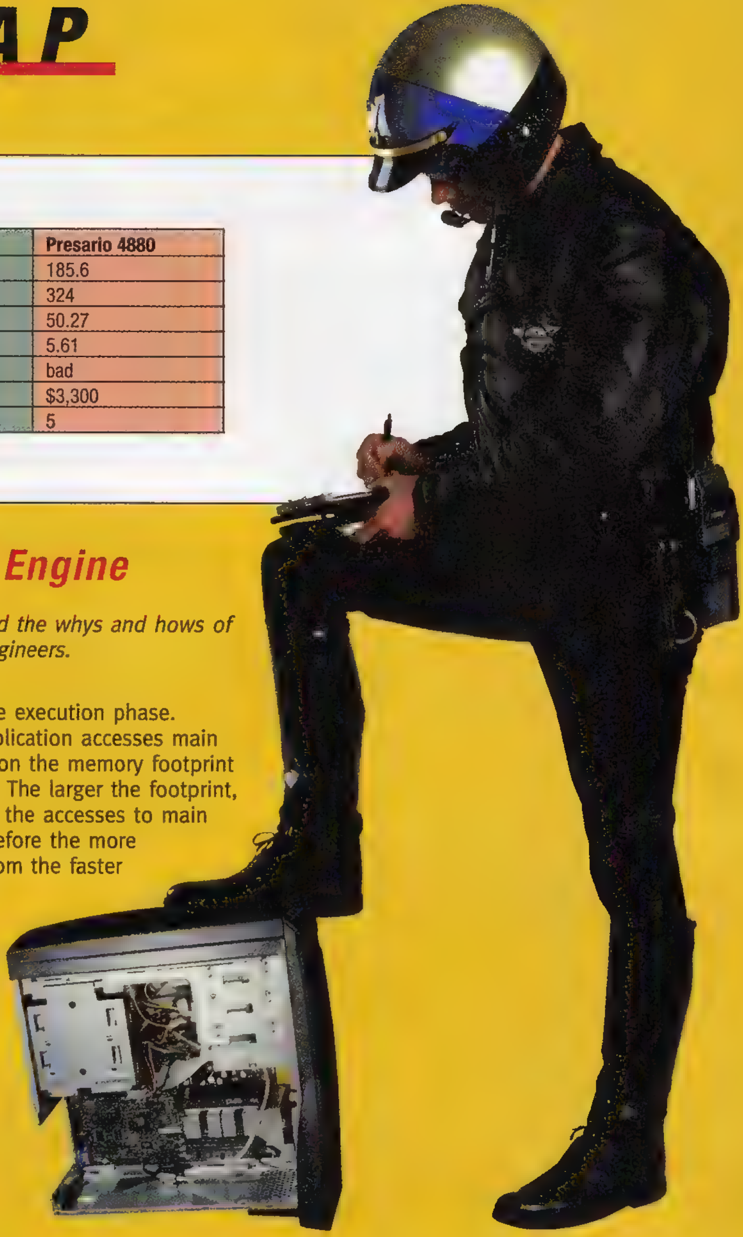
MAYBE HIGHER OCTANE GAS WOULD HELP

The immense aluminum heatsink makes the CPU look crazy-wicked, but don't be deceived by the gaudy detailing. The 400MHz processor and 64MB 100MHz SDRAM don't perform like other engines in this roundup.

Racing Results

	Direction SPB 400	Millennia Xi	Presario 4880
bootMark	192	192.1	185.6
SYSmark32	416	427	324
ForsakenMark	70	110.81	50.27
ThreadMark	6.34	7.14	5.61
upgrade-friendliness	excellent	good	bad
price w/monitor	$2,898	$3,850	$3,300
bootVerdict	9	8	5

The Direction and Millennia systems include 19-inch monitors.
The Presario includes a 17-inch. Add Voodoo^2 to the Direction for another $200.



Getting To Know Your New Turbo Engine

You shouldn't be working under the hood unless you understand the whys and hows of all your parts. Here's a little technology lesson care of Intel's engineers.

Q: We all know faster is better, but what particular role does the faster memory bus play in overall performance?

A: A PC system mainly consists of a processor, main memory, hard drive, graphics card and other peripheral devices. The portion of the application resident in the hard drive or CD-ROM is transferred to the main memory, from where it is then executed by the processor. The faster the processor accesses memory, the faster the application gets executed, resulting in higher performance. The 66MHz memory bus became a more profound bottleneck with the advent of faster and faster CPUs, and thus needed to scale upward to keep pace with processing speed.

Q: How did the 66MHz memory bus adversely affect 3D games? In what operations was the bottleneck most disruptive?

A: There are different stages within the 3D pipeline. The CPU is typically responsible for geometry calculations, physics, transformation, and setup. The graphics card is responsible for drawing the image on the screen; this is referred to as rasterization. All these stages contribute to the overall performance of the 3D game. Rasterization makes use of main memory to access textures for the scene. This is where the speed of the memory bus plays a role in 3D performance. The faster the accesses to main memory, the better the 3D visual experience. The AGP bus reduces the memory-bus bottleneck by providing the graphics card with direct access to main memory, where textures are stored.

Q: In what direct, tangible ways will we see the benefits of a 100MHz memory bus?

A: The 100MHz memory bus helps applications that make frequent accesses to main memory during the execution phase. How often the application accesses main memory depends on the memory footprint of the application. The larger the footprint, the more frequent the accesses to main memory, and therefore the more benefit you see from the faster bus. Applications with large data sets, such as Adobe *Photoshop* or high-end engineering/workstation applications, will benefit most from the 100MHz bus.

Q: Bus speed aside, how does the amount of system memory affect performance?

A: If a system doesn't have enough memory to hold both the application and the data used by the application, the OS will create extra memory space on the hard drive. The memory created on the hard drive is called virtual memory. When this is required, the OS will have to swap data between memory and the hard drive before continuing its work. This swapping, often referred to as "paging," can slow a system significantly, since it's basically working at the speed of the hard drive as opposed to the memory subsystem, which is more than six times faster. Once a system has enough memory to hold both application and data, any additional memory beyond that will have a small or negligible effect on system performance.

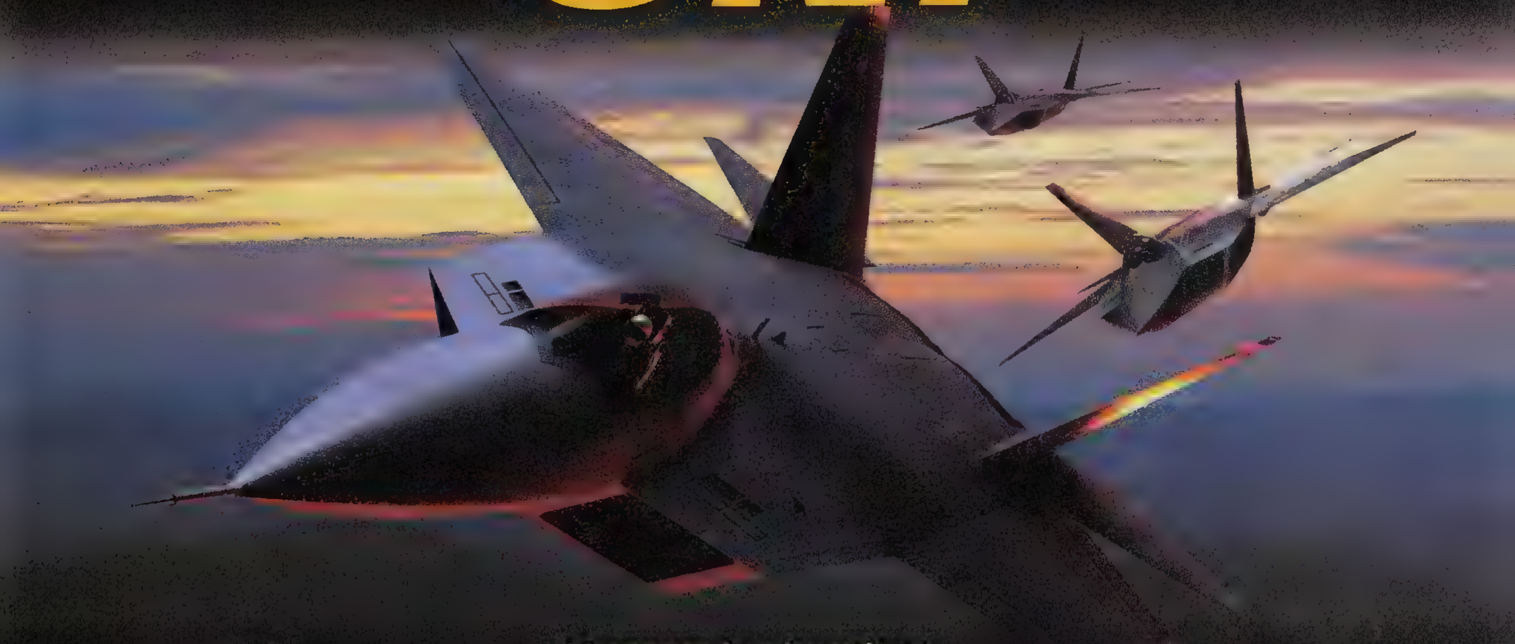
Q: What CPUs lie ahead in the Intel roadmap?

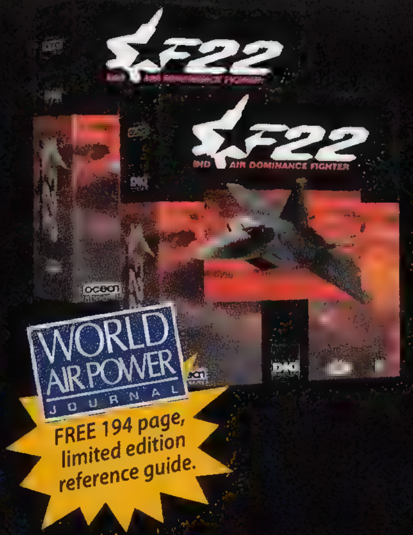
A: 400MHz Slot 2 CPUs will be available this summer, offering quad-processor support and up to 2MB of L2 cache running at core processor speed (an upgrade from 512K of L2 cache running at half the core processor speed). 450MHz Slot 1 and Slot 2 processors will be available sometime in the second half of 1998.

Q: How will larger amounts of L2 cache running at core processor speed benefit application performance?

A: View the L2 cache as a buffer between the processor and main system memory; it's closely coupled, temporary storage that the processor can access very quickly. If a system has a large and fast L2 cache, it will be able to hold more of the application and the data being used, thereby reducing the number of main memory accesses involved in running the application. Main memory is much slower than cache. Reducing main memory accesses by increasing the cache size speeds up execution and benefits performance.

FIGHT'S ON!





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Product Information Number 261

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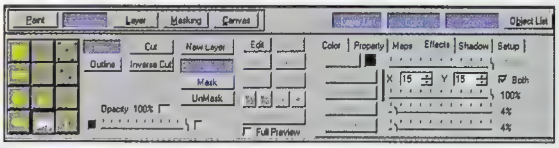
1 Know Your Interface

Before flying into the wild unknown, get to know *Satori*'s main interface. Five menu selection buttons—Paint, Geometry, Layer, Masking, and Canvas—dynamically toggle different control environments, each replete with scads of buttons for precision manipulation. Most of *Satori*'s features are exposed for easy access.



NOTE: To save bitmap files in version 1.6 you must also include the file extension in the filename.

2 Clone The Stone

A vital tool in any graphics studio is the Clone brush. You can use it for a whole bunch of sensible reasons—or you can use it for completely gratuitous fun. First, open an image of a friend, mother-in-law, celebrity, whatever. Now, from the **Paint** menu click **Clone**. Next, with the cursor in the image window, press the right mouse button to bring up the **Brush** menu. Select **Set Clone Offset** and you'll see the cursor turn into a rubber stamp. Place the rubber stamp over one of the subject's eyes and click. Now move to the forehead (where you want the copy of the eye to appear) and press the left mouse button. You'll notice that as you drag, a cursor is left at the source area and a second cursor is created at the destination (Figure 2a). The cursors remain displayed and locked whilst you clone a third eye by "painting in" the source pixels in the destination area. The result (Figure 2b) is surreal, but it gets even weirder when you begin playing with Sharon's ruby-red lips (Figure 2c). Human faces make ideal candidates for cloning shenanigans, because the uniformity of skin tone conceals where clone areas begin and end.

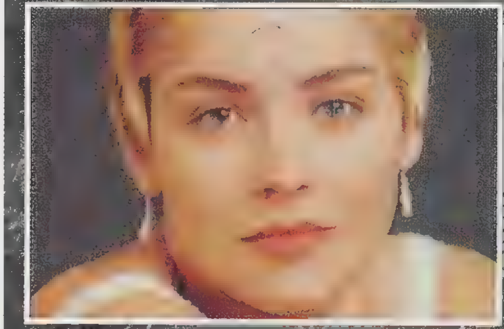


Figure 2a

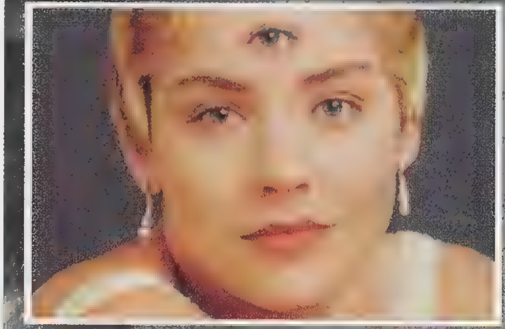


Figure 2b

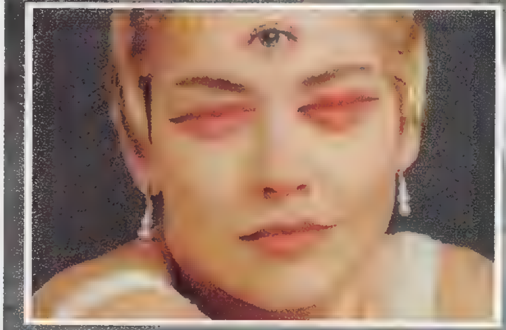
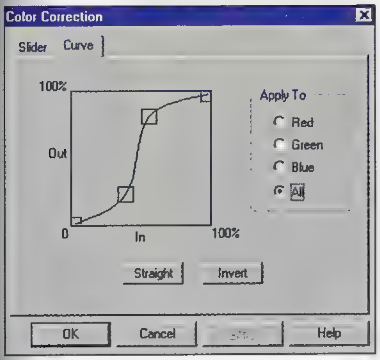


Figure 2c

3

Pretty Skies And Color Correction

We've all arrived at a beautiful location only to find rain or insufficient light for a decent photograph. This snap of King's College at Cambridge, for example, came out a bit drab (Figure 3). Fortunately, *Satori*'s **Color Correction** tool lets you adjust brightness, contrast, and component color values. There are two ways to adjust colors—using sliders or using curves (curves give beginners easier-to-use and more sweeping control). Experiment with different settings until you hit the right mix, then click **OK** to finish.


Color Correction

Apply To: ● All

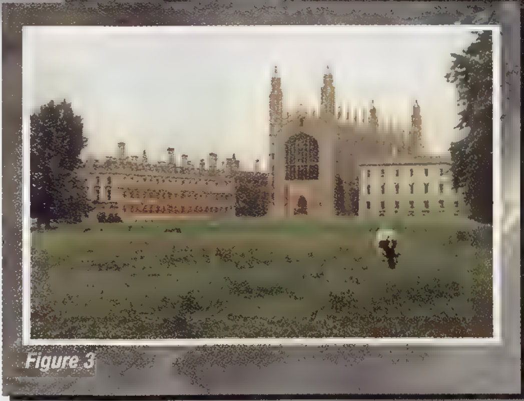
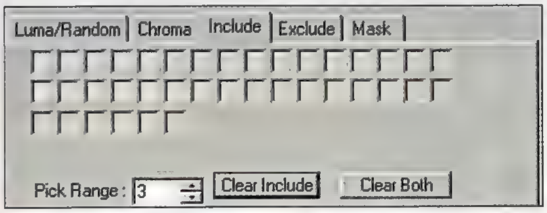


Figure 3

4

Chroma Chameleon

While we're in the business of improving this image, let's replace the gray sky completely. Open the **Masking** menu, click **Chroma** and select the **Include** tab. This is where you pick colors to be included in the chroma-removal process (each color in the swatch list will be zapped away). Set the **Pick** value and start picking those gray colors from the sky by clicking around inside the image window. When you think you have enough, click **Make Mask** and a user mask will be generated from those colors selected (Figure 4). It's almost certain that your first attempt will fail somehow—you probably won't grab every single color to be masked—but you can refine your selection and vary the values for Range and Falloff (in the **Chroma** tab) until you're happy.


Pick Range: 3

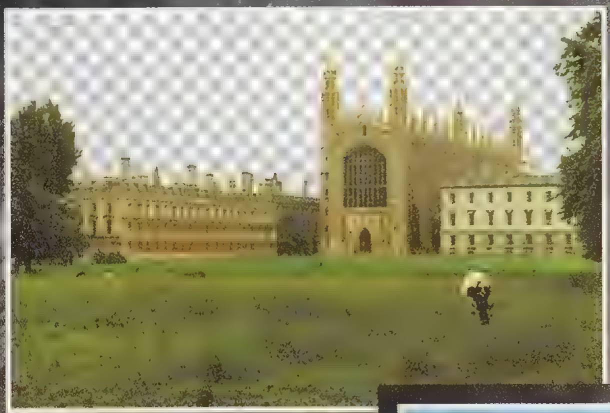


Figure 4

5

Blue Skies Shining

We now want to replace that sky with a completely different image. Use **Load To Layer** to open a file of a nice new sky, and move this new layer behind Layer 1. And lo! It is done (Figure 5). Be careful not to get carried away—it is England, remember—so there's no point in making the sky *too* blue.

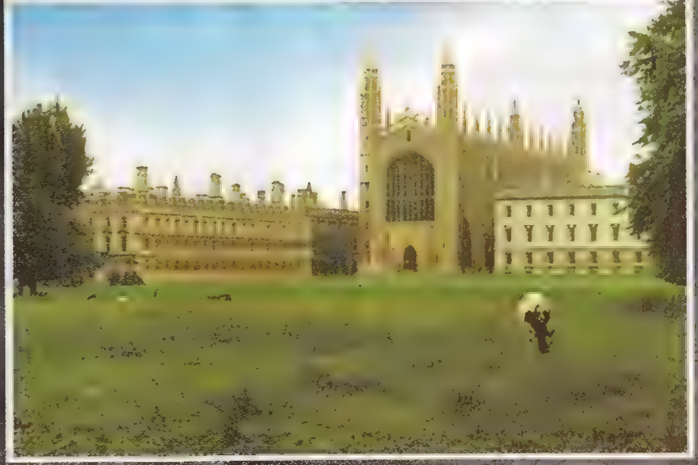


Figure 5

6

Man In The Luma Mask

Here's a neat trick to produce a startling and colorful composite from one photograph and a couple of textures. You can do this with any three images, and it takes just seconds at any size or resolution. Open the main image (Figure 6) and from the **Masking** menu click **Luma**, then **Make Mask** (0% to 100%). This makes a semi-transparent user mask based upon the brightness levels contained within the image, where dark areas are rendered transparent and light areas opaque (or vice versa). The excellent natural lighting in our sample image perfectly lends itself to luminance keying.

7

Let There Be Light

From the **Load To Layer** dialog, select the first texture file (Figure 7, a scan of a manipulated Polaroid), then click **Add To Layer**. You can either stretch the incoming texture to fit the shape of the canvas, or you can maintain its aspect ratio. We've given the first texture a color correction (see Step 2) to enhance the reds and yellows. It will key through the light areas of the main image, revealing the infinite background behind.

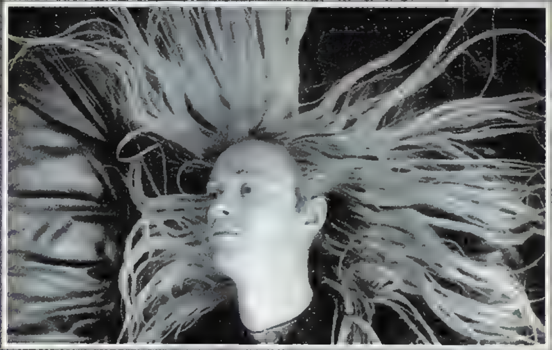


Figure 6

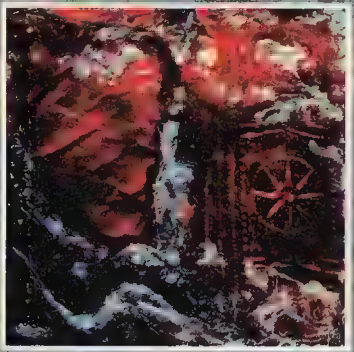


Figure 7

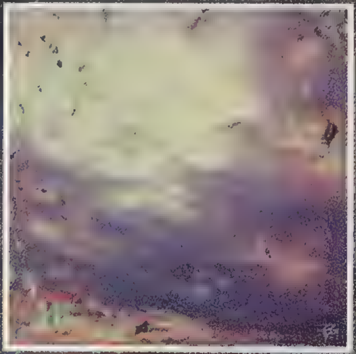
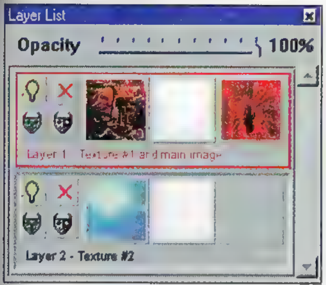


Figure 8a

8

Master Of The Elements

Open the second texture file (Figure 8a), click **New Layer** for your destination, and place it behind Layer 1 by dragging its position in the Layer List. The texture will key through the dark areas of the photograph. Use of heavy color correction produces contrasting colors (in this case, blues), and a blur filter will help to separate it from the foreground detail. To do this click the **Effects** tab in the **Geometry** menu, select **Blur**, and set a value. Next choose the **Rectangle** tool and draw a box where you want the blur to go. You can edit this as often as you like to get the perfect effect. The final image (Figure 8b) has a dramatic, elemental quality.



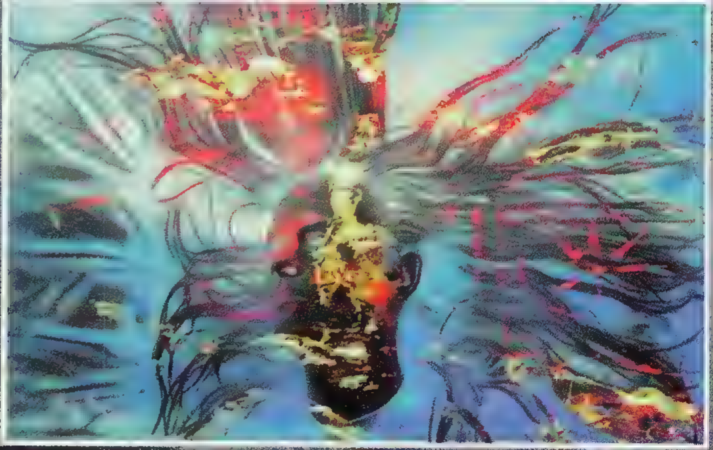


Figure 8b

9

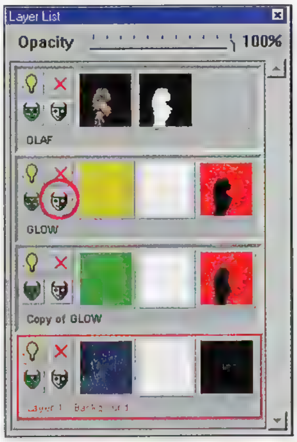
Olaf The Troll

Here's a technique you can use to add brilliant plasma glows to objects through some judicious masking. We're using an image of rocks for our background image and a frame from an animation of Olaf the Troll saved as a 32-bit TGA file. Load the background into Layer 1 and load the 32-bit file into Layer 2. Then make a new empty layer (it's a good idea to rename this layer as "Glow") and fill it with yellow by picking that color and placing it in the color box next to the **Clear** button on the **Layer** menu and then clicking **Clear** (choose Colored when you're asked to define clearing options).

10

Punch A Hole In The Troll

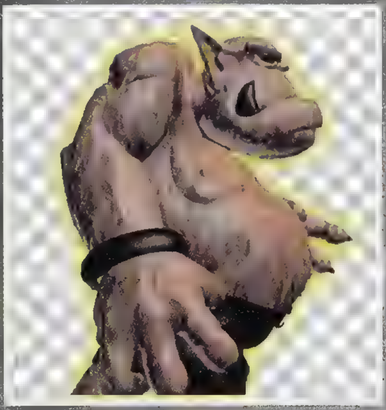
Next, from the **Load To Layer** menu click **Current Layer User Mask** and select the same 32-bit troll file as before. This will punch a troll-shaped hole (or mask) in the yellow color channel. You can invert this to produce a yellow troll silhouette by clicking on the **Invert Mask** icon on the **Layer List** palette. (Make sure your equivalent of the troll file has a transparent background; if the background is filled with color, it will punch an edge-to-edge rectangle instead of the proper shape.).



11

It's All A Blur

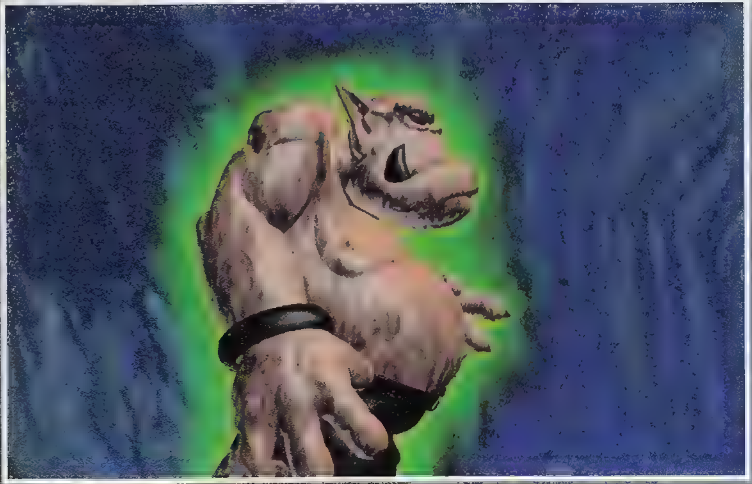
The next step is to apply a blur in the user-mask channel (about 10 pixels; see Step 7 above and be sure to apply this to the mask channel and *not* the color channel). Now move Layer 3 behind Layer 2 for a perfect yellow halo.



12

From Yellow To Green

The final step is to copy the "Glow" layer (click **Copy Layer** from the **Layer** menu), then click **Edit** in the **Geometry** menu, and choose bright green before clicking **Finish Edit** to change the yellow object to green. Next go to the **Effects** tab to increase the value for the blur to 50. Move this layer behind the previous glow layer for a really impressive yellow glow that decays to a truly ghoulish green.



12 STEP CLINIC

IRQS ACTING UP? VIDEO **DRIVERS** GETTING YOU **DOWN**? 3D CARDS HAVE YOU CAUGHT IN A **CONUNDRUM**? BOOT **EDITORS** ANSWER YOUR TOUGHEST **PC QUESTIONS**

When I'm 64

My Toshiba Infinia 233MHz is supposed to have 64MB RAM, but some programs and the BIOS says it only has 63. What's the deal?

Adam

Senior editor Andrew Sanchez replies: *When some programs measure your memory, they subtract your base 640K of memory. Many programs also take into account upper memory and round that up to about 1MB of base memory, leaving you with what you're seeing in your programs and BIOS. Trust us, you have 64MB.*

His Turn To Serve

Do you have any info on setting up *Quake II* so I'm the server and two friends hook directly up to my machine? I have a friend who wants to connect from the outside.

Brian Hentschel

Technical editor Sean Cleveland replies: *It's really easy if you have a static IP address. Just connect to your service provider like you normally do and then start your game using Start Network Server. Once started, your friends can join by either typing your IP address into their Address Book under Join Network Server in the Multiplayer options or by typing "connect <IP address>" in the Command Console, which is accessed by hitting the tilde (~) key. If you don't know your IP address, just start a game, bring down the Command Console, and look for your IP address under the Server Initialization heading. For more information, go to* **www.idsoftware.com/q2multiplayer/index.html**.

When Five Is Better Than 15

Between BNC and regular 15-pin VGA connectors, which is better and why?

Wes

Executive editor Jon Phillips replies: *BNC, which stands for British Naval Connector, is a locking coaxial cabling connector system used for high-bandwidth video as well as network I/O. When it comes to video displays, BNC connectors offer better high-frequency bandwidth than 15-pin connectors—less attenuation, which means sharper images for folks doing high-falutin' graphics work. BNC also allows for better shielding and longer cable lengths—you don't want to take 15-pin connections past six feet. On the flipside, BNC cables are much bulkier than 15-pin cables. In fact, five separate coaxial cables are required for a single video connection—one cable each for the red, green, and blue channels, one for vertical sync and one for horizontal sync.*

If you do professional design work or are having problems with your video signal, you should consider BNC. Otherwise, 15-pin should do just fine.

Use The Force, Luis

I recently bought a DB50XG daughtercard from Yamaha, hoping it would make synthesis on my old AWE32 sound like AdLib music [a competitor to the SoundBlaster format that never caught on]. Well, it does work, but only when playing XG files. Every time I throw some weird general MIDI file at it, some of the instrument sounds swap, in both DOS and WIN95. Does it have anything to do with the 548 or so instruments that XG adds to GM? Or is it that I haven't loaded some weird patch? Please help me, you're my only hope!

Luis José Romero

Senior editor Andrew Sanchez replies: *You may need to reset your MIDI synthesizer. Most MIDI cards come with some type of DOS utility software that resets your wavetable card in case something weird happens, such as system-exclusive messages found within XG and MIDI files that change your MIDI characteristics. For example, on Roland's SCC-1 card, Roland packed a program appropriately titled GSRESET that does this exact thing. Yamaha should also pack its own reset program with its daughtercard. Simply run that to reset your card to normal GMIDI.*

> "I have an old Socket 5 P100 and would like to purchase a new **Socket 7** motherboard. Will the **Socket 5** fit and work in the Socket 7 board?"

Dimmi More

I'm looking into adding more memory, but I want some advice from the experts first.

- Can you run SIMMs and DIMMs at the same time in order to increase overall memory, or must they remain separate?
- Which is the better memory formfactor, DIMM or SIMM?
- Which is the better memory type, EDO DRAM or SDRAM?
- Can you recommend a moderately priced brand of the better type?

Steve Anderson

Senior editor Andrew Sanchez replies: *You can run SIMMs and DIMMs together successfully. But you will take a performance hit. Consult your manual to see which sockets to use.*

The 168-pin DIMM is better because of its 64-bit data path; only one DIMM is required to get your system to work. 72-pin SIMMs need to work in pairs, because of their 32-bit paths. DIMMs also move at faster speeds, allowing memory makers to toss on 100MHz or faster SDRAM. EDO DRAM can also appear on DIMMs, but avoid these if you plan on going with a system bus that's 75MHz or faster.

SDRAM is faster than EDO DRAM, running at faster clock speeds. SDRAM mates perfectly with Intel's 440BX, Via's MVP3, and other core-logic chipsets. Unless your chipset just doesn't support SDRAM, don't go the EDO route. It's a dying RAM platform that'll give way to SDRAM and Rambus.

It's difficult to name the best brand of memory. Low-cost DIMMs are all over the market. In northern California, you can get a 64MB SDRAM DIMM for $160. If you plan on running at a 100MHz system-bus speed, make sure to get SDRAM that's tested and approved at that speed. Companies such as Kingston, Micron, and Hyundai make 100MHz SDRAM that is signed, sealed, and ready to go.

Droppin' A Load

I have a 200MHz Pentium with Win95, *Internet Explorer 4.0*, *Office 97*, and a few other programs that load automatically when I boot up. I know I can have different logins, but I can't figure out how to boot to a clean system for gaming. Before I loaded *IE* and *Office* my games were noticeably faster, but now I notice when I boot I have less memory. Any help would be appreciated.

Don

Technical editor Sean Cleveland replies: *You can bypass anything that may load via your Startup group by holding down the Shift key while booting into Windows. If an app is loading but not through Startup, it is loading from a section in your Registry. You can edit your Registry by running RegEdit from the Run applet in your Startup menu. The section that loads apps on boot up is located in the following section:*

HKEY_LOCAL_MACHINE
SOFTWARE\Microsoft\Windows
Current Version\Run

Be careful what you do, as the slightest boo-boo can have cataclysmic effects.

The Old CPU Switcheroo

How would someone really know what speed processor he has? I'm supposed to have a 266MHz P-II, but how do I really know that's what I've been sold? What if a company overclocked it to 266MHz? And aren't many CPUs exactly the same architecturally, but clocked at different speeds?

Xfaction

Senior editor Andrew Sanchez replies: *You're absolutely correct in the assumption that many CPUs are the same architecturally, though clocked at different speeds. As individual CPUs are put through manufacturer speed tests, those that run successfully at a higher speed are oftentimes branded as such, and those that fail are labeled one bin lower.*

In terms of the rated speed of what you purchased, the best way to find out is to actually look *at the CPU. On a Pentium II, look for the letters "PY" on the top edge of the cartridge. Immediately behind that will be a three-digit number; this represents the manufacturer's rated speed in MHz. So, PY350 denotes a 350MHz CPU. On Socket 7 chips, you'll need to yank off the heatsink in order to get a good look. If your system's BIOS boot-up screen shows a 266MHz chip installed, but it says 233 on the CPU, then you know you've been had.*

"I was **wondering** whether I could backup C: to D: then install the new C: drive, boot off a Win95 boot disk, and then copy files over to the new C:?"

Suffering Socketash

I have an old Socket 5 Pentium 100MHz and would like to purchase a new Socket 7 motherboard. Will the Socket 5 fit and work in the Socket 7 board? The board I'm looking at is the FIC PA2007 with the VP2 chipset and 1MB L2 cache. The FIC web site says it will take Pentium 90MHz on up. Does this mean Socket 5?

Corey

***Senior editor Andrew Sanchez replies:** Provided the motherboard's chipset supports your CPU—which is highly likely as the minimum these days for new motherboards is a Pentium 90MHz—then you'll be good to go. Socket 5 refers to an older Pentium spec that is upward-compatible pin-for-pin with Socket 7. In fact, I recently upgraded one of my old CPUs (a P90 on a Socket 5 motherboard with Vesa Local Bus slots!) to a 430TX-based Socket 7 mainboard with no problems whatsoever. So rock on.*

Mirror Image

I would like your opinion on the best way to replace my current C: drive (540MB) with a new 3.2GB drive. I was wondering whether I could backup C: to D: then install the new C: drive, boot off a Win95 boot disk, and then copy files over to the new C:? That sounds too easy, so it's probably not possible.

Terry Fortag

***Technical editor Sean Cleveland replies:** Why waste all that time? There's third-party software available that makes this upgrade process a snap. Check out Drive Copy from PowerQuest. This kick-ass product (boot 17) will clone your existing hard drive and dynamically create and increase the partition sizes on the new larger drive. You may also want to look into GHOST (General Hardware Oriented System Transfer), cloning software available on the Internet. It also dynamically partitions and formats on-the-fly. More info can be found at* **www.ghostsoft.com**. *A time-limited demo is also available.*

The Boggy Mire Of Win95

At my office, we just received two custom spec machines that came preloaded with Win95 (one partition, FAT32). They're dog slow! My machine takes forever to boot up and hangs for about five to ten seconds when opening a program. Same thing when I try to open a file or close a program. It never crashes. It just keeps "sticking." I loaded NT4.0 on it with no problems, and it screams! Not a single hang-up. Whazzup?

Stephen Gill

***Technical editor Sean Cleveland replies:** Your problem most likely resides in the "preloaded" version of Windows 95. It's probably loading a bunch of unneeded software and drivers. I say this because you report that NT4.0 screams—so it's not a hardware problem. Uninstall any software you don't use and get some software to clean up your registry (such as Network Associates'* Nuts & Bolts *or Symantec's* Norton Utilities 3.0*). Also, turn off "Auto insert notification" on both your CD-ROM and hard drives to get rid of any polling that may occur in the background (this may account for some of the "sticking" you describe).*

11 Pancake Breakfasts And A Bottomless Cup Of Advice

My new computer is a P-II 233MHz with an AGP ATI All-In-Wonder Pro card and American Megatrends ATC-6120 motherboard. I want to replace the ATI card, as good as it is, with a Jazz Adrenaline Rush. The problem is that I've removed the ATI card and installed the Jazz, but keep getting a "no signal" message on my monitor. I know the card works, because I've tested it in my old system.

I followed the original Jazz instructions, and my monitor is brand new and works. I've also tried fiddling with the various CMOS settings, according to Jazz Tech Support advice, but to no avail. If you guys could help me resolve this dilemma, I would buy you guys all lunch at IHOP! Seriously, any help regarding this matter would be great, and if I can't use my Jazz card, could you suggest a kick-ass 2D card and 3Dfx Voodoo or Voodoo^2 combo?

Donald Cathcart

***Senior editor Andrew Sanchez replies:** First, go in the CMOS and make sure you're allocating an IRQ for your videocard. Second, try slapping the Adrenaline Rush in another PCI slot. Also make sure the card is properly seated in the PCI slot. If your motherboard is mounted ever so slightly off-center, screwing in the videocard may pull the card out of the PCI slot by a hair, thus denying contact with some of the bus pins. To test for this, try firing up the system without screwing the videocard down. Make sure the card is sitting properly and be very careful when you attach the monitor cable to the videocard. You do not want to move the computer once you do this, because you may wind up yanking the card out of the slot, and with the power on, that's a bad thing.*

For a killer two-card combo, try either Matrox's Millennium II or Number Nine's Revolution 3D for 2D duties alongside a Voodoo-based board. ▮

Overclocker's Corner

Jim Likes His Stealth Steamy

If I overclock my Stealth II to 60MHz and use it on a 66MHz bus, it runs fine. Now, if I run it on a 75MHz bus, am I overclocking it even more? Does the videocard's processor run at a multiple of the PCI bus MHz? I ask because I'm getting ready to move to a 233 P-II LX-based option and don't want to fry my card by over-overclocking the chip. The video processor has a 486 heatsink and fan on it.

Jim McNabb

***Senior editor Andrew Sanchez replies:** By overclocking your system bus to 75MHz, you'll be boosting the PCI bus to about 37.5MHz (75/2), which may prove to be unstable for some videocards. In terms of the actual videocard processor, it runs at its own set speed, independent of the system bus. The only way to test stability is to actually try the overclocking you've proposed. If you encounter visual glitches or lock-ups, then it's time to ease up.*

Gene's Stuck On Route 66

I have a P200 MMX with a VXPro+ motherboard. After reading all the boot stuff on overclocking, I finally mustered the courage to try it. My system is set at 66MHz x 3.0—but the next jumper setting is noted as 1.5x/3.5x. When I used this setting and booted, the system showed it was running at 166MHz, even though 1.5 x 66 is 99. What's the deal? Is my only recourse to try bumping up to 75MHz from 66 and still use the 3.0 multiplier?

Gene

***Technical editor Sean Cleveland replies:** Your dilemma is indeed odd. It shouldn't have come up at 166MHz. I assume you tried 3.5x at 66MHz and it didn't work. This would have increased your CPU speed to 233MHz. I would have tried the 3.0x setting at 75MHz myself. This would increase your bus speed—and the speed at which your PCI cards communicate with the system—and push the CPU speed to 225MHz.*

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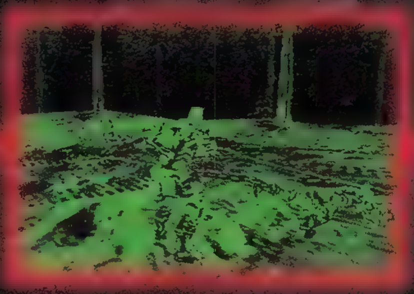

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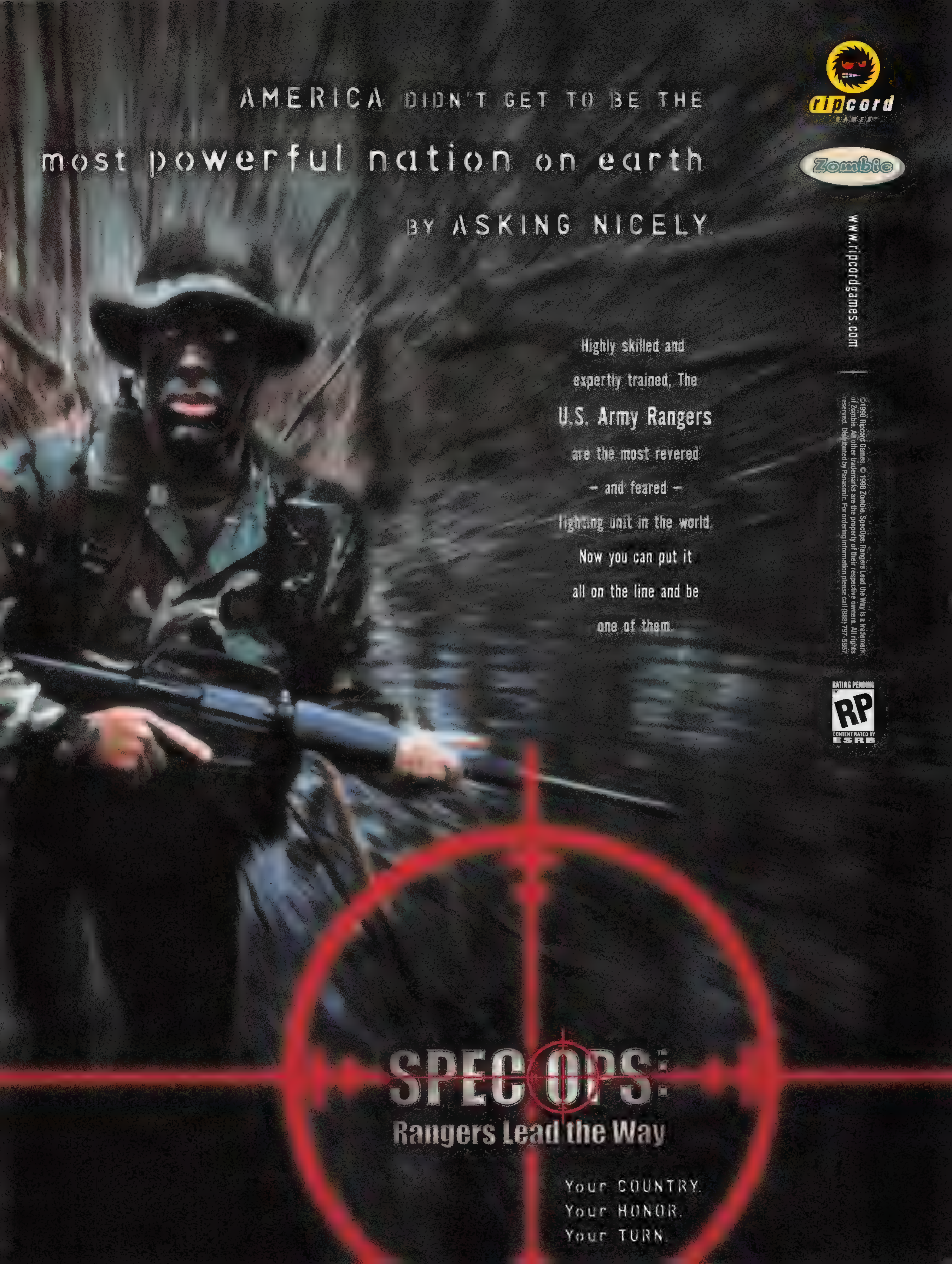

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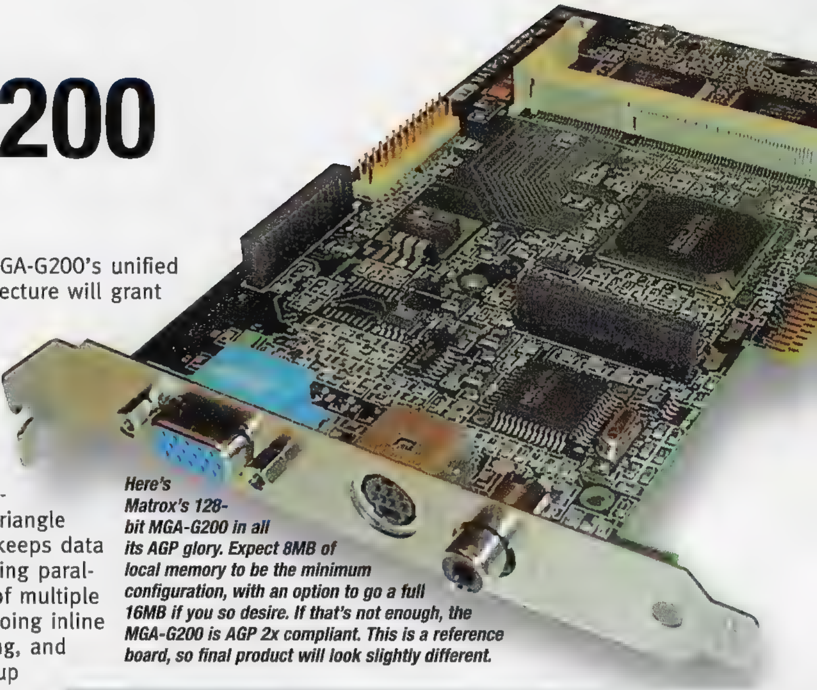
Matrox **MGA-G200**

Voodoo^2 killer incognito

HANDS-ON boot exclusive

After long refusing to implement common features—such as bilinear filtering and stippled fogging—that would bring its 3D offerings up to speed with its dominant 2D parts, Matrox will finally step up with its MGA-G200. This no-compromise next-gen architecture promises to pack a sledgehammer combo of 2D and 3D performance that could leave even Voodoo^2 face down in the dirt.

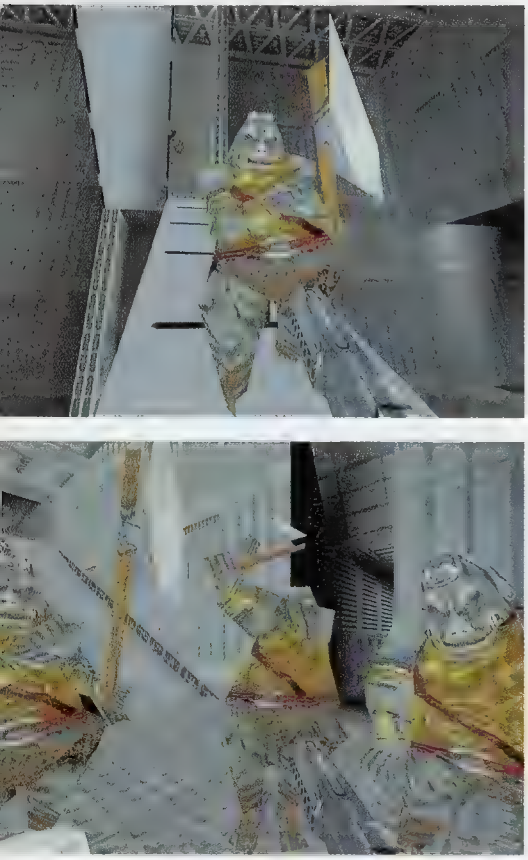
The .25-micron MGA-G200 packs twin 64-bit buses operating in parallel for a grand total of 128 bits of processing power (called the 128-bit DualBus). Not only will this speed up 3D operations, it also promises close to double the Millennium II's 2D performance. Combined with a 230MHz or 250MHz RAMDAC and up to 16MB of SDRAM/SGRAM, the MGA-G200's unified memory architecture will grant faster 2D with those eye-caressing refresh rates you've grown to love. A fully programmable floating-point/integer triangle setup engine keeps data flowing, pumping parallel execution of multiple instructions, doing inline backface culling, and more. The setup engine also handles calculations for triangles, fans, strips, and vectors, resulting in an estimated throughput of over 1.5-million triangles per second. An on-chip cache also comes standard.



Here's Matrox's 128-bit MGA-G200 in all its AGP glory. Expect 8MB of local memory to be the minimum configuration, with an option to go a full 16MB if you so desire. If that's not enough, the MGA-G200 is AGP 2x compliant. This is a reference board, so final product will look slightly different.

Feature Set and 2D Performance

Max 24-bit resolution/refresh rate	1800x1440/70Hz or 1600x1200/90Hz
Max 16-bit resolution/refresh rate	1800x1440/70Hz or 1600x1200/90Hz
DOS Quake (640x480)	31.7fps
DOS Quake (800x600)	22.7fps
MDK PerfTest v1.4 (DirectDraw)	116
Final Reality Radial Blur (DirectDraw)	29.91fps
Final Reality Chaos Zoomer (DirectDraw)	47.50fps



***Jedi Knight** at 1280x1024? Yupper! And this is but one of the many strengths the MGA-G200 has in its Voodoo^2-killing arsenal. All this, and that sweet 2D, too.*

And this time out, Matrox didn't skimp on 3D features. Perspective correction, bilinear/trilinear filtering, per-pixel mip-mapping, edge anti-aliasing, true-color RPG gouraud shading, and specular highlights are just some of the features hiding inside the MGA-G200. Depth cuing and fogging effects are also present. While it doesn't perform multitexturing in a single pass, Matrox may support the feature in multiple passes without taking too brutal a performance hit.

What can Matrox's next chipset offer that Voodoo^2 cannot? Voodoo^2's Z-buffer is limited to 16 bits—as opposed to the MGA-G200's double- or triple-buffered 16-bit or 32-bit Z-buffer. Expect resolutions playable up to 1280x1024 at 32-bit/double-buffered. Matrox claims D3D6-specific functions will be supported, but which ones remain to be seen.

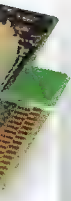
Matrox is also incorporating a unique rendering process known as Vibrant Color Quality. In a nutshell, the MGA-G200 internally processes all rendering operations at 32-bit accuracy using source texture maps, and the output is then dithered down to a 16-bit palette. This, in theory, should result in sharp, precise visual quality without dotted artifacts, and over-blurred or washed-out textures.

The MGA-G200 is designed to be API agnostic, so Direct3D and OpenGL ICD/MCDs will allow games, as well as high-end CAD/CAM apps, to take advantage of the MGA-G200's 128-bit pipeline. Unfortunately, MSI—Matrox's proprietary API—will not be supported, leaving any custom ports sitting in the closet. The drivers for the MGA-G200 will be backward compatible, so Millennium II and its ilk can immediately take advantage of any improvements in the G200 drivers.

For expansion-bus-ophiles, the MGA-G200 will deliver as both a PCI 2.1 bus-mastering card or a full AGP 2x with sidebands.

Never straying far from the video front, the MGA-G200 will employ a modular design when it comes to adding features. Attach the appropriate daughtercard onto the main videocard's various header connectors for additional functionality, such as hardware MPEG-2 DVD decoding, video capture, and more. These treats will all straddle the video card, as opposed to taking up precious PCI slots.

The MGA-G200 talks the talk, but can it walk the walk? The early alpha 8MB

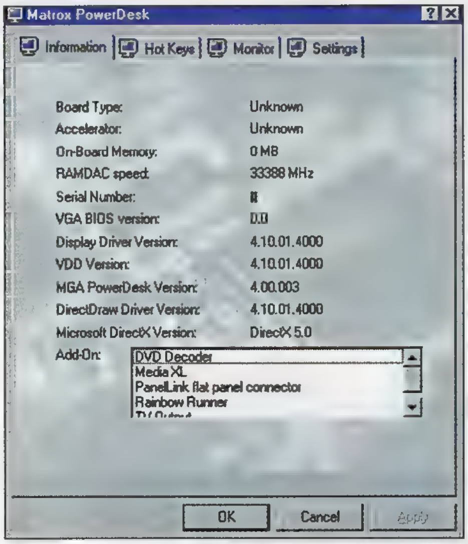


Dare to Compare

	Matrox MGA-G200 *	3Dfx Voodoo^2	nVidia Riva 128	Intel i740
Bus Interface	AGP 2x	PCI	AGP 1x	AGP 2x
Test System	P-II 300MHz	P-II 300MHz	P-II 300MHz	P-II 300MHz
ForsakenMark (D3D)				
640x480	93.59fps	108.20fps	71.67fps	64.63fps
800x600	55.89fps	57.93fps	54.24fps	41.98fps
1024x768	N/A *	Failed	N/A	29.67fps
X (D3D)				
640x480	79.83fps	92.54fps	69.82fps	66.63fps
800x600	N/A *	81.85fps	59.88fps	50.31fps
1024x768	N/A *	56.53fps	43.12fps	44.93fps
Turok v1.01 (D3D)**				
640x480	48.9fps	62.8fps	50.6fps	39.4fps
800x600	33.7fps	44.9fps	34.2fps	26.3fps

** These scores for the MGA-G200 are taken from one-month-old silicon and alpha drivers. The silicon is also clocked at about 50% capacity—expect final shipping product performance to be even faster.*
*** Due to the early nature of these drivers, we could not get results from these tests.*

AGP reference board Matrox sent us clocked at roughly 70% of full capacity, and the preliminary results are stunning, to say the least. The ForsakenMark at 640x480 jammed at an incredible 93fps. nVidia's Riva 128, the closest competitor in a 2D/3D solution, is 21fps behind. The 3D-only Voodoo2 sits safely out of reach at 108fps, but not for long.



Board Type: Unknown
Accelerator: Unknown
On-Board Memory: 0 MB
RAMDAC speed: 33388 MHz
Serial Number: 0
VGA BIOS version: 0.0
Display Driver Version: 4.10.01.4000
VDD Version: 4.10.01.4000
MGA PowerDesk Version: 4.00.003
DirectDraw Driver Version: 4.10.01.4000
Microsoft DirectX Version: DirectX 5.0
Add-On: DVD Decoder
Media XL
PanelLink flat panel connector
Rainbow Runner

Matrox's infamous Control Applet, which gives you minute control of your display, will be present.

Considering we saw three-to-four-week-old silicon and drivers, these numbers are most impressive. Visual quality was also darn sweet, *Forsaken*'s alpha-blending and mixed colored lighting appear appropriately, as did *Turok*'s table-fogging effects, although there was visible banding during our *X* tests.

Still, Matrox is taking steps to fix any and all problems before the product ships in June.

Pushing the hardware even harder, we fired up *Jedi Knight* at 1280x1024, and while frame rates hovered between 12fps and 30fps, it was playable and sharp as a Ginsu knife. DirectDraw and DOS speeds were comparable with Intel and nVidia's current champions, so older games will feel this new processor's push. Unfortunately, GL drivers weren't ready for any Quake-based madness, but promises to be ready for prime-time when the cards are released.

Pricing, board configurations, and options on MGA-G200-based boards should be announced by May, with low-end G100-based boards, including the Productiva G100 and Mystique G100-DVD board, well on their way toward completion.

The MGA-G200 is a dark horse in this year's 3D race, but if Matrox can pull it together, the company may have the integrated 2D/3D weapon that'll have the last laugh after all.

—Andrew Sanchez

product info

Available June 1998
Price TBA
Company Matrox
Phone 800.361.1408
URL www.matrox.com/mgaweb

HARDWARE ON THE HORIZON AND SOFTWARE SOON TO SHIP

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Chromatic Research Mpact 2 3DVD 68
Jane's F-15 69

The boot Tracking Sheet

TITLE	*DEVELOPER*	*DATE*
Celeron/CPU	***Intel***	***4/98***
Mobile Deschutes	***Intel***	***4/98***
K6 3D	***AMD***	***Q2/98***
nVidia Riva 128ZX	***nVidia***	***Q2/98***
V2000 3D Conspiracy	***Rendition***	***Q2/98***
Requiem	*3DO/Cyclone Studios*	*Q2/98*
Extreme Warfare	*Trilobyte/Red Orb*	*Q2/98*
Grand Prix Legends	*Papyrus/Sierra Online*	*Q2/98*
Reno Air Racing	*Papyrus/Sierra Online*	*Q2/98*
MechCommander	*Microprose*	*Q2/98*
The Dark Project	*Eidos/Looking Glass*	*Q2/98*
Riot	*Microsoft*	*Q2/98*
Grim Fandango	*LucasArts*	*Q2/98*
Dark Vengeance	*Reality Bytes*	*Q2/98*
Descent: Free Space	*Interplay/Volition*	*Q2/98*
Daikatana	*Ion Storm/Eidos*	*Q2/98*
Matrox MGA-G100	***Matrox***	***6/98***
Matrox MGA-G200	***Matrox***	***6/98***
PowerVR Second Generation	***NEC/VideoLogic***	***Q3/98***
Aureal Vortex	***Aureal***	***Q3/98***
Cayenne 266MHz	***Cyrix***	***Q3/98***
Pentium II/Slot 2	***Intel***	***Q3/98***
450NX AGPset	***Intel***	***Q3/98***
440LX-R AGPset	***Intel***	***Q3/98***
450NX AGPset/w PIIX6	***Intel***	***Q3/98***
nVidia NV4	***nVidia***	***Q3/98***
Kings Quest: Mask of Eternity	*Sierra*	*Q3/98*
10th Planet	*Bethesda*	*Q3/98*
Messiah	*Shiny/Interplay*	*Q3/98*
Windows 98/Memphis	*Microsoft*	*Q3/98*
Duke Nukem Forever	*3D Realms*	*Q3/98*
Star Trek: Klingon Honor Guard	*Microprose*	*Q3/98*
Verite V3000	***Rendition***	***Q4/98***
Banshee	***3Dfx***	***Q4/98***
Final Fantasy VII	*Squaresoft/Eidos*	*Q4/98*
Descent III	*Interplay/ Outrage Entertainment*	*Q4/98*
Prey	*3D Realms*	*Q4/98*
Shooter	*Ion Storm*	*Q4/98*
Starship Troopers	*Microprose*	*Q4/98*
Windows NT 5.0	*Microsoft*	*Q4/98*
K6+3D	***AMD***	***Q4/98***
Katmai	***Intel***	***Q4/98-Q1/99***

**These dates are subject to change*
***Bold indicates hardware*

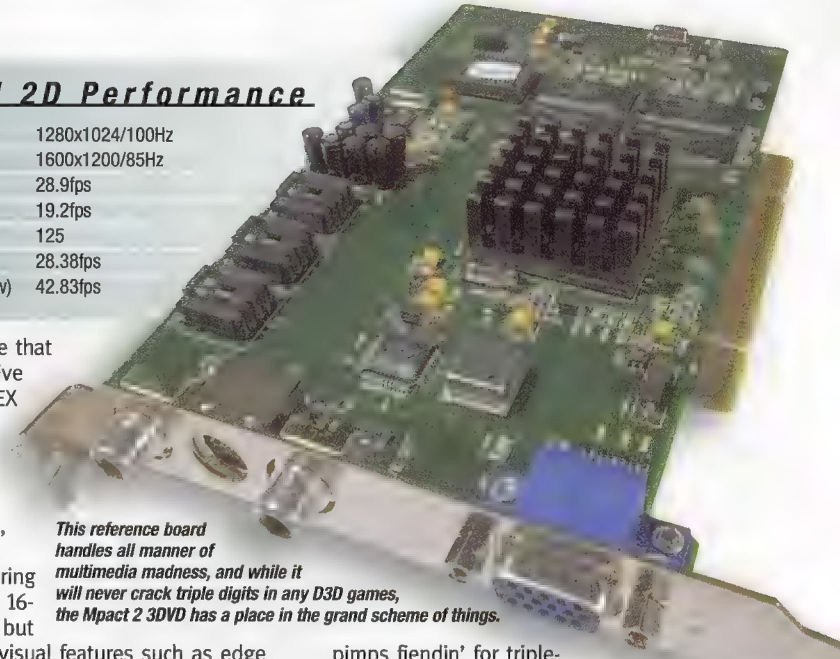
Chromatic Research **Mpact 2** 3DVD

A triple-D delight

All-in-one media accelerators have never really succeeded. Just ask nVidia about its phat-but-ultimately-flat NV1 processor. But Chromatic Research still plans to invade the sub-$1,000 market with its latest all-in-one processing prowess. Packing more "D's" than a Russ Meyer flick, Chromatic Research's Mpact 2 3DVD attempts to give you 2D, 3D, and DVD in a single 352-pad Ball-Grid-Array package... and more!

Feature Set and 2D Performance

Max 24-bit resolution/refresh rate	1280x1024/100Hz
Max 16-bit resolution/refresh rate	1600x1200/85Hz
DOS Quake (640x480)	28.9fps
DOS Quake (800x600)	19.2fps
MDK PerfTest v1.4 (DirectDraw)	125
Final Reality Radial Blur (DirectDraw)	28.38fps
Final Reality Chaos Zoomer (DirectDraw)	42.83fps



This reference board handles all manner of multimedia madness, and while it will never crack triple digits in any D3D games, the Mpact 2 3DVD has a place in the grand scheme of things.

The Mpact 2 3DVD media processor is a videocard, first and foremost. Its high-density VLSI innards house five internal controllers that keep tabs on all manner of multimedia functionality, including:

2D features are VESA 2.0 and Win95/DirectDraw compliant

3D includes a Direct3D hardware accelerator

Video includes DVD, MPEG-1, MPEG-2 decoding, and NTSC/PAL video outputs

Sound includes digital audio such as Dolby Digital AC-3 decoding and SRS-True Surround

A related piece, the Mpact 2 3DMAX, also incorporates fax/modem and telephony.

All this is handled via the Mpact 2 3DVD solo VLIW/SIMD processor, which is capable of up to six billion operations per second. With a little help from Mpact's Mediaware real-time kernel, simultaneous execution of these functions is possible.

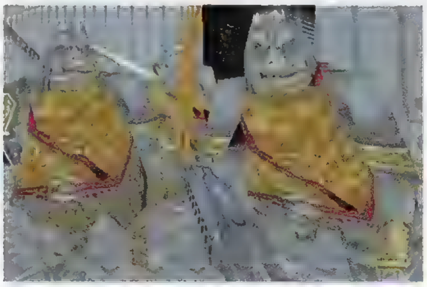
On the 3D side, the chip fully supports DirectX 5, with a firmware floating-point setup engine that handles native D3DTLVERTEX support (for indexed and non-indexed triangle lists, strips, and fans). Rendering is limited to 16-bit Z-buffer, but it will push visual features such as edge anti-aliasing, alpha-blending, bilinear/trilinear filtering, and per-pixel mip-mapping.

The Direct3D Gauntlet

ForsakenMark	**Mpact 2**
640x480	38.39fps
800x600	38.39fps
1024x768	20.16fps
X	
640x480	40.94fps
800x600	29.96fps
1024x768	21.12fps
Turok Dinosaur Hunter (v1.2)	
640x480	30.2fps
800x600	20.6fps
Final Reality	
25pixel	227.56Kpoly/sec
Fill Rate	11.21Mpixels/sec

Unlike boards relying on SDRAM/SGRAM or EDO, the Mpact 2 3DVD relies on Rambus technology for local memory. Via two 9-bit-wide 300MHz Rambus channels of DRAM, vendors can opt for a minimum of 4MB all the way up to 8MB for higher resolutions (with a little help from the 230MHz 24-bit RAMDAC).

Another major function of the Mpact 2 3DVD is its hardware MPEG-2/AC-3 decoding capabilities, which kills the need for an add-in dedicated card. The processor promises to sustain full NTSC 59.94fps video output at up to 720-pixels per line on the MPEG-2 side, while audio action can occur via the 36-bit internal precision, CD-quality output with variable sampling rates. A tri-mode 48KHz SPDIF can be linked with the appropriate receiver for hair-raising aural delights. Boards will come either in PCI 2.1 or AGP 1x DMA flavors.



Jedi Knight ***at 640x480 is quite playable at 30-odd fps.***

With an 8MB PCI reference board in tow, we took the Mpact 2 3DVD out for a spin. On our 300MHz Pentium II test bed, the initial results may not excite hardcore pixel pimps fiendin' for triple-digit performance—640x480 *Forsaken* coughed up 38fps, while *X* forked out 40fps. Despite these slower scores, all visual effects were performed perfectly, from *Turok*'s table fogging effects to *Forsaken*'s various alpha-blends. But none of the 3D accelerators we've seen could work hardware DVD decoding and AC-3 manipulation all on the same chip, and with PCI slots becoming more of a commodity, an all-in-one setup starts to look more appealing.

Vendors such as STB and Diamond have announced products based on the Mpact 2 3DVD, while major OEMs also plan to incorporate this handy-dandy technology in their systems. Perhaps the "media processor" may finally get the respect it so desperately yearns for.

—Andrew Sanchez

product info

***Available* Q2 1998**

***Price* TBA**

***Company* Chromatic Research**

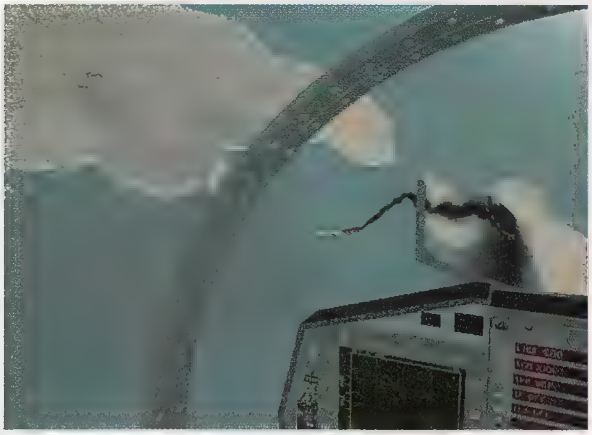
***Phone* 408.752.9100**

***URL* www.mpact.com**

Jane's **F-15**

The Eagle has landed

Dust off that flightstick and prepare to take command of an F-15 Strike Eagle in Jane's Combat Simulation's latest hardcore flight sim, F-15. ***Andy Hollis****, the man with the plan behind the original* F-15 Strike Eagle *series for Microprose, is now busting out his latest F-15 sim. This time,* F-15 *will pack all the visual angst and intensely realistic, joystick-breaking action that only 3D acceleration and the team at SkunkWorks can provide. We got a lock on Hollis and engaged him to reveal all of* F-15*'s secrets.*



A MIG takes one up the tailpipe and sputters to a graceful death.

boot The F-22 is the fighter du jour for flight-sim developers, why choose the aging F-15 Strike Eagle?

Hollis I'd hardly call the F-15E Strike Eagle "aging," since it first went operational in 1988. Certainly, the original F-15 has been around awhile (since the mid-70s), but the dual-role E-model is still in its prime.

We chose the F-15E because, first, we like the latest, sexiest aircraft with all the "cosmic" avionics gear and high-performance airframes. Second, we value a proven combat legacy. Third, it has to be an aircraft with both air-to-air and ground-pounding missions. Finally, we have to be able to get our hands on the real aircraft, the operator's manuals, and experienced pilots.

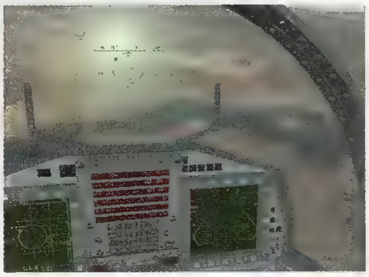
boot Everyone claims their flight sim is the "state of the art" in realism and accuracy. What will* F-15 *bring to the table?

Hollis We've broken new ground in several areas. The flight model is based on the same formulas that the USAF's commercial-grade simulators use. That flight model is fed stability-derivative data obtained from NASA and USAF tests. On top of that sits the F-15E's computer-assisted flight-control system, which we've modeled in great detail. Finally, because no theoretical model is perfect, we work with real F-15 pilots to tweak the simulation.

A lot of attention has been paid to the more casual gamer. All the realistic stuff can be toned down to a more action-oriented experience with a single-options selection (or anything in between).

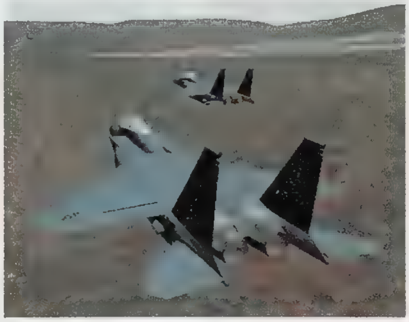
boot What missions will* F-15 *have?

Hollis In Instant Action, the player is placed in a target-rich environment with a full load of ordnance and plenty of jet fuel. Second, short training exercises teach you a single tactical item (e.g., how to fire a Sidewinder missile, how to drop an unguided bomb). There's also a comprehensive mission builder and a series of single missions.



Jane's F-15*'s will have the same kick-ass views as previous offerings, thanks to a texture-mapped polygon virtual cockpit.*

Finally, there are two dynamic campaigns. The first is an exploration of the F-15E's role in Desert Shield/Desert Storm. The second campaign is a near-future conflict set in the hills and coasts of Iran in 2002. Because it is hypothetical and dynamic, it'll be completely different every time you play. All this action takes place over a simulation "world" of almost three million square miles that includes the entire Middle East.



The world generator promises to build upon Longbow 2*'s exquisite rolling hills and textured terrain.*

boot What graphics engine will* F-15 *use?

Hollis The engine was built from scratch to be fast both in software rendering and with 3Dfx hardware support. By staying with 8-bit graphics at 640x480, we get a high-quality look and keep the frame rate up. The polygon-based engine uses a unique method of texture tiling that uses very little texture space yet still gets a varied world look. As such, it doesn't need to load terrain texture data off the hard drive or CD during flight and can easily be optimized for 3D acceleration. And *F15*'s high-res textures don't get blurry when you get close to the ground.

boot Will you take advantage of AGP for the larger textures?

Hollis Because the engine was originally designed before 3D acceleration, we've kept texture sizes small. As such, AGP is not a requirement and will only serve to give better overall rendering speed.

boot What about visual effects?

Hollis *F-15* features lens flares, light-sourcing, colored lighting, and more. Terrain and objects are full textured, smoothly real-time lit, with spectral reflections, multiple layers of translucencies, and real-time shadows. There's a particle system used for damage bits flying off airplanes and for multilayered explosions. The 3D objects themselves are fully articulated, with working control surfaces, animated landing gear, etc., and are textured with "materials" of varying reflectivity. When the weather is clear, you can see up to 30 miles in the distance.

boot* F-15 Strike Eagle III *had some of the coolest multiplayer around-how will it be implemented in* F-15*?

Hollis With multiplayer, we chose to concentrate on the most-requested form of play, head-to-head dogfighting. Up to eight players can enter and leave on-the-fly. You can fly as a free-for-all or in teams of any size, and there are configurable options for weapons rules and starting positions. Latency issues have been tamed through high-performance smoothing algorithms applied to eliminate the dreaded positional warping seen in many other sims. TCP/IP, IPX/LAN, modem, and direct serial are all supported as connection methods.

product info

Available	***Q2 98***
Price	***TBA***
Developer	***SkunkWorks***
Publisher	***Electronic Arts***
Phone	***800.245.4525***
URL	***www.janes.ea.com***

REVIEWS

KICKIN' THE TIRES ON
THE LATEST **HARDWARE**
AND TAKIN' THE NEWEST
SOFTWARE OUT FOR A SPIN

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Touchstone PC-cillin 3.0 88
Inoculan AntiVirus 5.0 89
Norton AntiVirus 4.0 89

bootLab **Policy**

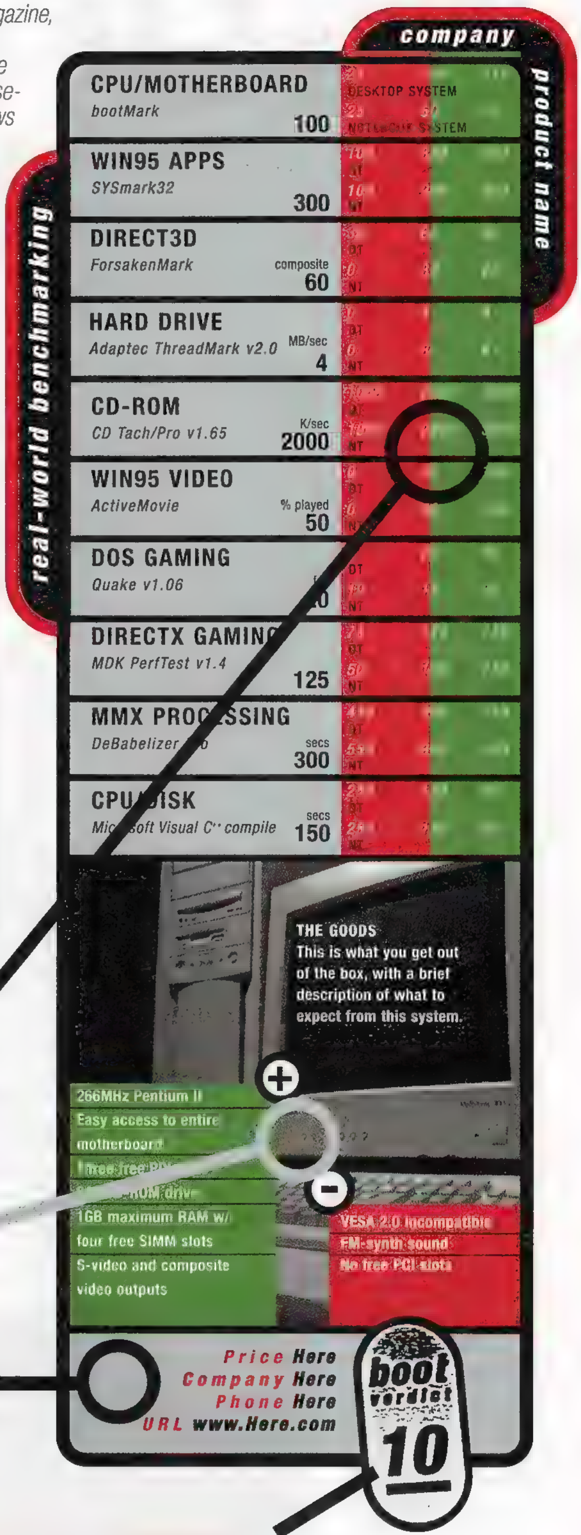
boot *isn't like any other computer magazine, and neither is our product-**evaluation** process. We don't test equipment in the cold, sterile environment of a warehouse-sized lab, and we don't write our reviews based on the **test scores** that labcoat-wearing technicians scribble on clipboards.*

*Our review **scores** are based on a combination of objective **benchmark** testing, real-world performance, and our subjective evaluation of features, performance, and the many less tangible **characteristics** that go into a product. All our evaluations are based on **hands-on** use of the product.*

3D Benchmarks

Final Reality and X

We've added two new tests to our 3D benchmarking bag of tricks. X is an upcoming Direct3D space-combat and trading game from EgoSoft. The demo runs through a scripted series of scenes and reports an average frame rate. Final Reality, *a comprehensive 2D/3D benchmark developed by VNU European Labs, is based around a game engine from Remedy Entertainment's upcoming* Max Payne. *It tests several fly-through scenes, as well as some abstract performance tests. Look for both new tests on the bootDisc.*



company
product name
real-world benchmarking
CPU/MOTHERBOARD
bootMark
100
DESKTOP SYSTEM
NOTEBOOK SYSTEM
WIN95 APPS
SYSmark32
300
DIRECT3D
ForsakenMark
composite
60
HARD DRIVE
Adaptec ThreadMark v2.0
MB/sec
4
CD-ROM
CD Tach/Pro v1.65
K/sec
2000
WIN95 VIDEO
ActiveMovie
% played
50
DOS GAMING
Quake v1.06
DIRECTX GAMING
MDK PerfTest v1.4
125
MMX PROCESSING
DeBabelizer
secs
300
CPU/DISK
Microsoft Visual C++ compile
secs
150
266MHz Pentium II
Easy access to entire motherboard
Three free P
-ROM drive
1GB maximum RAM w/ four free SIMM slots
S-video and composite video outputs
VESA 2.0 incompatible
FM-synth sound
No free PCI slots
Price Here
Company Here
Phone Here
URL www.Here.com
boot verdict
10

THE GOODS
This is what you get out of the box, with a brief description of what to expect from this system.

REAL-WORLD BENCHMARKING
The new meter has the precise scores for each category benchmarked. Plus, the color bars to the right give you a quick idea of how well the system performed in that category.

It's simple: The farther right the bar reaches, the better the system scored. Green means the system performed on par or beyond what we expect of a current system. If you see nothing but red, the system performed below expectations.

PLUSES AND MINUSES
Here's where we list the best and worst a system has to offer.

CONTACTS
Look here for price and the company's phone number and URL if you want more information.

boot KICK ASS! PRODUCT

Only the **best** earn enough respect to be worthy of our **editors'-choice** award.

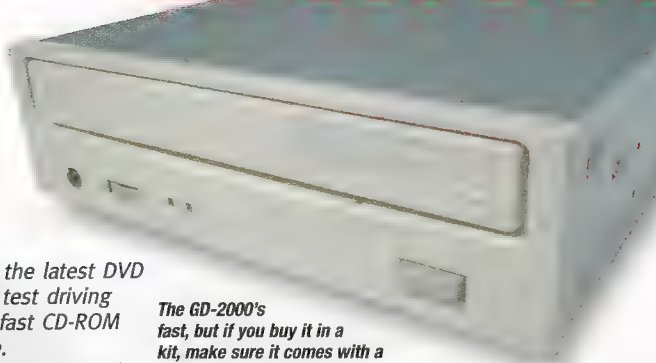
BOOT VERDICT
The one that really matters. This score reflects how we feel about a system, taking into account the benchmark results, quality of parts, usability, overall performance, and our intense, under-the-hood scrutiny.

Waiting Game

Next-generation DVD-ROMs today

DVD is here to stay, but the question is: "Should I shell out $500 for the latest DVD drive, or wait and just drop $100 on a new 32x CD-ROM drive?" After test driving two of the newest IDE DVD drives from Sony and Hitachi, we'd get a fast CD-ROM drive now and hold off until more interactive DVD content is available.

—Rick Popko



The GD-2000's fast, but if you buy it in a kit, make sure it comes with a respectable decoder card.

Hitachi GD-2000

The GD-2000 was the faster of the two DVD drives here (coming in with a respectable 6.4x speed in the CD Tach test). Where we encountered problems was with the LuxSoner MPEG-2 playback board Hitachi sent with the drive: It didn't work with the ATI Rage Pro in our test system. When we went to its web site, we found that LuxSoner was still working on help and driver support for its board. After a couple of calls, Hitachi admitted that the board sent to us was still in beta, but assured us its drive was not. So, for the purpose of this review, we evaluated only the drive, using the Sigma Hollywood 2 card that came with the Sony drive. Hitachi says it will be selling its drive separately, unlike Sony, which will sell only bundles, because it wants to eliminate hardware conflicts that might arise with the MPEG-2 hardware currently on the market.

Like the Sony, the Hitachi drive passed all our backward-compatibility tests. It played *Total Recall* and *Jumanji* perfectly, it recognized our CD-R discs (albeit with a five to six second lag), and it was able to copy files from a bootDisc to our hard drive. The Hitachi was fast, but if you're going to buy the GD-2000 in an upgrade kit, keep a wary eye on which decoder card Hitachi bundles with the drive.

Price $219
Company Hitachi
Phone 800.448.2244
URL www.hitachi.com

boot verdict 7

Sony DDU100E

The DDU100E is slow. While it played *Total Recall* and *Jumanji* flawlessly, the DDU100E lagged during our CD and DVD Tach and CD-to-hard-disk file-transfer tests (it took whopping 25 minutes to transfer 642MB of data to our internal drive).

Did we mention that it's slow?

Sony's DVD kit was pleasure to install, but it's slow as molasses.

What we liked about the DDU100E was its ease of installation, its easy-to-follow documentation, and the included Sigma Designs Hollywood 2 decoder card. The decoder card includes composite and S-Video out (sorry folks, no component) and an optional S/PDIF output for Dolby Digital Surround Sound. Sigma Designs also supplies a VCR-type remote control GUI for fast forwarding, jumping tracks, and switching from Pan and Scan to Letterbox. And while the pause button worked great, there was no frame-advance feature. As we casually clicked buttons, we noticed a loss of audio sync after alternately hitting the fast-forward button and the play button. Pressing the pause button and the play button again rectified the problem.

DVD movie playback to our TV monitor was smooth and clear (just like a DVD set-top box). VGA movie playback was smooth and slightly fuzzy. However, compared with any other algorithm, such as MPEG-1, CD-I, or Indeo Interactive, the quality of full-screen VGA video from Sony's drive was the best video we've seen on a computer monitor. If you want to use this drive to watch a film, lug your PC into the living room and hook it up to your big-screen TV. Still, we're going to wait and see what Sony's next-generation drive looks like.

Price $449
Company Sony
Phone 800.352.7669
URL www.sony.com/storagebysony

boot verdict 6

Dare to Compare

	Hitachi GD-2000	Sony DDU100E
Interface	CLV	CAV
Drive Type	ATAPI	ATAPI
DVD Tach Read Tests		
Read 16K Outside Tracks (K/sec)	2,797	1,665
Read 16K Center Tracks (K/sec)	2,797	1,663
Read 16K Inside Tracks (K/sec)	2,796	1,663
Full-Stroke Seek (ms)	212	555
Random-Access Seek (ms)	163	586
CPU Utilization @1x (1,352K/sec)	43%	44%
CPU Utilization @2x (2,704K/sec)	63%	Failed
2K Burst (K/sec)	2,580	2,010
8K Burst (K/sec)	3,116	2,752
16K Burst (K/sec)	2,424	2,928
CD Tach Drive Speed (DVD)	2.1x	1.2x
CD Tach Read Tests		
Read 16K Outside Tracks (K/sec)	1,469	621
Read 16K Center Tracks (K/sec)	1,139	592
Read 16K Inside Tracks (K/sec)	657	621
Full-Stroke Seek (ms)	546	714
Random-Access Seek (ms)	137	495
CPU Utilization @2x (300K/sec)	6%	23%
CPU Utilization @4x (600K/sec)	13%	46%
CPU Utilization @6x (900K/sec)	19%	Failed
CPU Utilization @8x (1,200K/sec)	26%	Failed
2K Burst (K/sec)	2,765	1,831
8K Burst (K/sec)	5,958	2,660
16K Burst (K/sec)	7,549	2,841
CD Tach Drive Speed (CD)	6.4x	4.1x
CD-to-HD Transfer 642MB	11:34	25:58

All drives tested with Toshiba Infinia 7260

What to Consider

1. Check the vendor's web site and make sure the included DVD decoder card is compatible with your videocard.

2. Don't buy based on the drive name alone. If you're buying a bundle, make sure it includes a respectable hardware MPEG-2 decoder card.

3. While DVD has features such as multiple languages, letterbox, alternative camera angles, and subtitles, not every DVD title has these features. So if you're playing Showgirls *and find you can't get the Japanese subtitles working, it's not because your disc is defective, it's because the title's creators opted not to put that interactivity on the disc.*

4. If you're buying DVD primarily to watch movies, make sure there's a store in your area with a good supply of titles. As of this writing, not every film production company is on the DVD bandwagon.

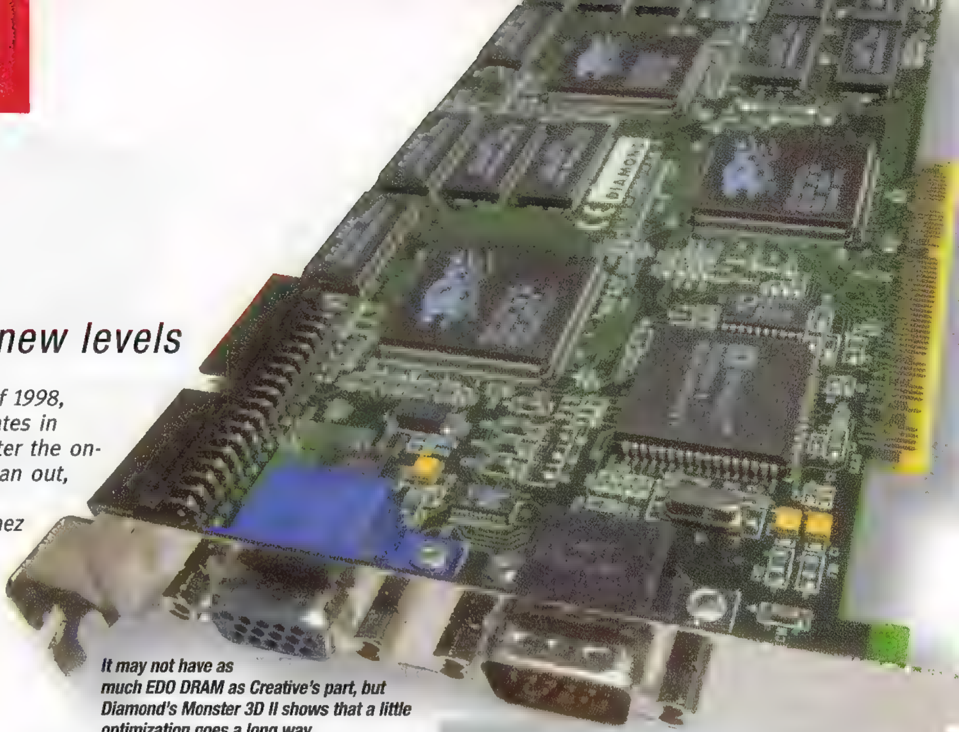
5. Know the difference between original ware and shovel ware. Many companies are shoveling multidisc CD-ROMs onto one DVD as a cost-saving measure. On the other hand, some companies are putting better video and audio quality in a title's intro and cut scenes. But as far as gameplay is concerned, don't expect longer, deeper gameplay.

VooDeux

3Dfx's latest takes 3D to new levels

Arguably the most anticipated 3D hardware of 1998, Voodoo^2 promised to nail triple-digit frame rates in everyone's favorite fragfest, Quake II, *no matter the on-screen situation. Alas, that promise doesn't pan out, but there's still a lot here to lust after.*

—Andrew Sanchez



It may not have as much EDO DRAM as Creative's part, but Diamond's Monster 3D II shows that a little optimization goes a long way.

Diamond Monster 3D II

boot KICK ASS! PRODUCT

Diamond, whose Monster 3D was a staple of the original 3Dfx offerings, is initially opting for an 8MB configuration of its Voodoo^2 part—4MB for the pixelfx2 chip, and 2MB for each of the two texelfx2 chips. Diamond has announced plans to release a 12MB board shortly, although one wasn't available in time for this review.

Fortunately, the missing 4MB doesn't hinder the Monster 3D II's performance. In fact, it edged out Creative's 12MB Voodoo^2 in every test. And look at those scores—no D3D game fell below 60fps on 640x480, and as for GL gaming—this card even makes *Hexen II* fluid. While neither board made it to 100fps nirvana in classic *GLQuake*, the 88fps posted is nothing to scoff at. But without a second board in tow, 800x600 is the max Z-buffered res you'll get. Games relying on a software Z-buffer (such as *X*) will run on Voodoo^2 at higher resolutions.

The Monster 3D II's reference Voodoo^2 drivers (Win95 and NT4.0) have been refined for separate D3D and Glide options within advanced options. More importantly, a slider allows the ambitious to alter their Monster 3D II's clock settings from 90Hz to 95Hz. But overclocking the rig really jacks up the heat, and the card already runs on the warm side. The default is 92Hz, which is where we conducted our tests.

Throw in an intense software bundle and a limited-time $50 rebate for current Monster 3D owners and the Monster 3D II brings affordable arcade-caliber performance to your PC.

Pay to Play

Voodoo^2's dance-hall delight is best served with a fast processor. Our sister publication, PC Gamer, tested the 3D Blaster Voodoo^2 on a Pentium 233MMX with 32MB of EDO DRAM, and scores were at least 30% to 40% slower than our scores on a Pentium II 300MHz test bed.

	Dual Voodoo^2 SLI	Voodoo^2 (single)
ForsakenMark (D3D)		
640x480	62.15fps	56.12fps
800x600	49.15fps	43.93fps
X (D3D)		
640x480	64.5fps	54.25fps
800x600	51.92fps	48.125fps
GLQuake II v3.10 (OpenGL)		
640x480	42.5fps	40.2fps
800x600	39.8fps	33.4fps

The Voodoo^2 Showdown

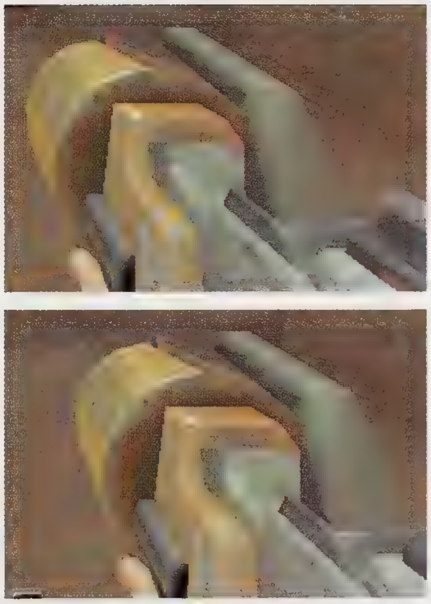
Benchmark	**3D Blaster Voodoo^2** Dual Voodoo^2 SLI	**3D Blaster Voodoo^2** Voodoo^2 (single)	**Monster 3D II** Voodoo^2 (single)	**Monster 3D II** Dual Voodoo^2 SLI
System Tested	P-II 300MHz	P-II 300MHz	P-II 300MHz	P-II 300MHz
ForsakenMark (D3D)				
640x480	114.18fps	108.20fps	109.48fps	111.91fps
800x600	110.21fps	57.93fps	58.72fps	110.53fps
1024x768	80.29fps	Failed	Failed	81.15fps
X (D3D)				
640x480	95.25fps	92.54fps	91.96fps	82.24fps
800x600	93.25fps	81.85fps	82.19fps	80.96fps
1024x768	71.29fps	56.53fps	58.04fps	67.26fps
Turok v1.01 * (D3D)				
640x480	82.1fps	62.8fps	64.9fps	74.7fps
800x600	70.4fps	44.9fps	45.9fps	68.7fps
GLQuake II v3.10 (OpenGL)				
640x480	68.9fps	53.5fps	56.2fps	62.9fps
800x600	61.3fps	43.7fps	43.8fps	60.0fps
1024x768	44.6fps	N/A	N/A	45.0fps
GLHexen II (OpenGL)				
640x480	49.0fps	40.6fps	41.2fps	46.5fps
800x600	44.4fps	29.6fps	30.0fps	42.9fps
GLQuake (OpenGL)				
640x480	88.2fps	86.6fps	88.1fps	90.0fps
800x600	61.4fps	55.4fps	56.6fps	62.5fps

** New version of* Turok *benchmark used (v1.01).*

THE STATS Win95 Drivers: 4.10.01.0200 I D3D drivers: 4.10.01.0200
THE BUNDLE Special Edition Star Wars Game Pack I *Heavy Gear* (full retail version with special multipass lighting effects) I *Tomb Raider II SE* I Eidos Interactive movie and demo sampler (with titles such as *Daikatana, Final Fantasy VII, Flight Unlimited II,* and *Joint Strike Fighter*)

Price *$249 ($50 rebate for current Monster 3D owners)*
Company *Diamond Multimedia*
Phone *800.468.5846*
URL *www.diamondmm.com*

boot verdict 9



In the Advance Properties section, 3Dfx has added a new Glide-specific advanced rendering filter, which promised better visual quality at the cost of speed. When engaged, it gets rid of the horizontal banding effects often seen in 3Dfx screenshots. On the top is a shot of* Quake II *with the filter engaged, on the bottom is your standard filtering system.

Too Old for Its Own Glide Good

While 3Dfx never promised Voodoo^2's backward compatibility, it all comes down to which version of Glide the application in question was compiled with. Older games will most likely choke on Voodoo^2 (just like Voodoo Rush).

Unfortunately, if the publisher doesn't cough up any newer versions of its games, you're out of luck. That copy of Toshinden *will make a great coaster. Too bad 3Dfx couldn't bundle all these patches as part of its OEM deal with Creative Labs and Diamond.*

We grabbed a random gaggle of Glide games, and fired them up. Here are our results:

Wing Commander Prophecy	Passed
Longbow 2	Passed
Myth: The Fallen Lords	Passed, though it requires the latest version (1.2) to work properly.
X-Car:	Failed. The game bombed out, giving us a "MIP map cannot span 2MB boundary" error message. No patch was available at the time of this review.
Heavy Gear:	Passed
Battle Arena Toshinden	Failed. While the game remained locked in at 30fps, the color palettes are horribly wrong.
Sub Culture	Passed
MageSlayer	Passed
Incubation	Passed
Joint Strike Fighters	Failed. Current version refuses to acknowledge 3Dfx hardware is installed.
Pod	Passed

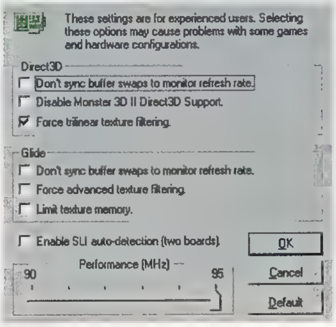
Creative Labs' 3D Blaster Voodoo^2

There's so much EDO DRAM love on Creative Labs' board, it has to park on both sides of the PCB, but being first to market doesn't come without a price.

Creative followed 3Dfx's board and driver reference design to the tee. As a result, the control panel applet lacks any special perks. But instead of the 1.5-inch ribbon cable 3Dfx spec'd for SLI, Creative bundles a 3-inch, which they claim may create visual glitches beyond 800x600 at refresh rates higher than 75Hz, due to impedance. Still, we didn't see any problems during our tests.

Performance is literally neck-and-neck with Diamond's offering, but that extra 4MB doesn't help the 3D Blaster slip past the Monster 3D II. Time and again, it missed the Monster by a frame or two, proving a little optimization goes a long way.

The nonexistent software bundle pales in comparison to Diamond's offerings, but Creative holds the honor of being first with a 12MB Voodoo^2 board, so RAM hungry 3D connoisseurs are sure to eat this thing up. A cool $600 will score you a dual-SLI combo that bestows you the ultimate polygon power in the universe today.



These settings are for experienced users. Selecting these options may cause problems with some games and hardware configurations.

Direct3D
- ☐ Don't sync buffer swaps to monitor refresh rate.
- ☐ Disable Monster 3D II Direct3D Support.
- ☑ Force trilinear texture filtering.

Glide
- ☐ Don't sync buffer swaps to monitor refresh rate.
- ☐ Force advanced texture filtering.
- ☐ Limit texture memory.

☐ Enable SLI auto-detection (two boards).

Performance (MHz) 90 – 95

From here, you can overclock that ol' Voodoo^2—oh yeah!

Creative Labs went whole-hog by packing 12MB of EDO DRAM in its 3D Blaster Voodoo^2.

THE STATS Win95 Drivers: 4.10.01.0015 | D3D Drivers: 4.10.01.0052-RC1
THE BUNDLE None

Price $299
Company Creative Labs
Phone 800.998.5227
URL www.creativelabs.com

boot verdict 9

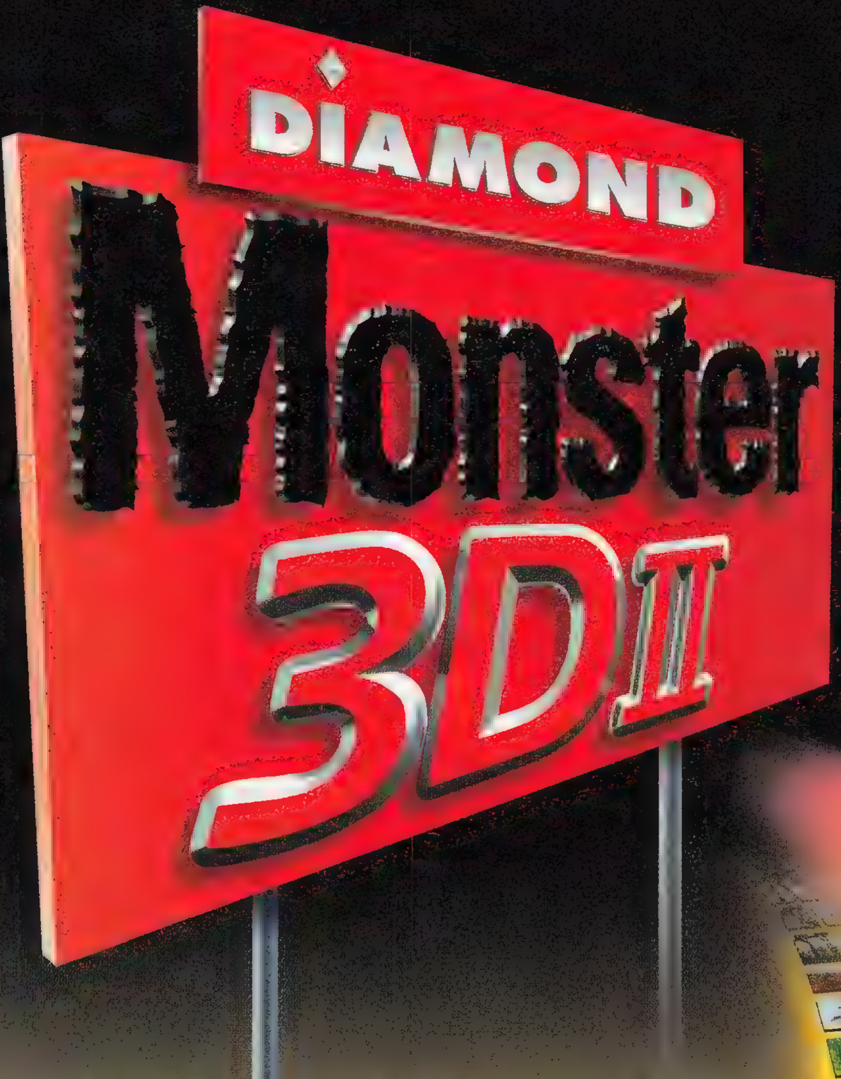
SLI = More Bounce to Your Ounce

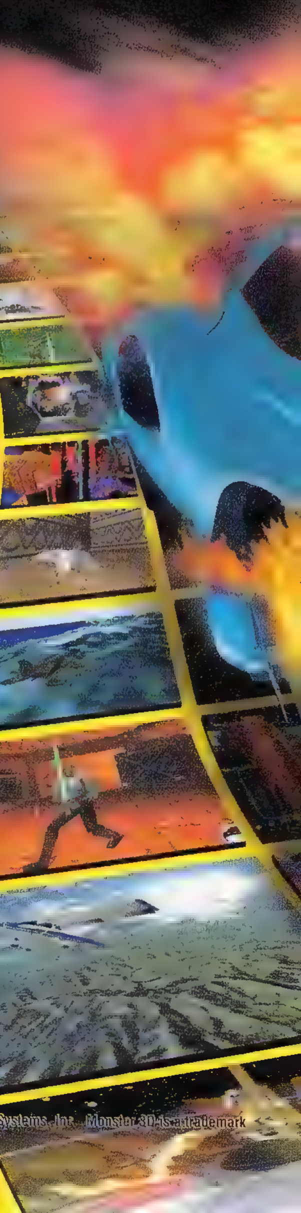
Running two 3Dfx cards is nothing new—Quantum 3D's been doing it for years. But Voodoo^2 brings this concept down to the consumer level. Scan Line Interleave (SLI) mode runs two cards together, with each card processing every other scan line. When coupled, apps see both units as one phat 3D accelerator.

Installing SLI is simple—slip that second board in and tether the ribbon cable between the boards. Install the second set of drivers and you're ready to rumble.

Dual-12MB 3D Blaster Voodoo^2 boards in our 300MHz P-II demonstrated just how much more jiggle we could wiggle. D3D gaming at 640x480 shows some improvement, but when you surpass 800x600 SLI's awesome power is unveiled. Performance increased anywhere from some 10% all the way up to a whopping 100%! A single Voodoo2 board freaked in at 57fps in Forsaken, *the SLI regime superfreaked 110fps! And 1024x768 pumped 80 freakin' frames-per-second. No other videocard can touch this performance at such high resolutions.*

And, you haven't lived till you've played Quake II *at 1024x768. Screw anti-aliasing. At these resolutions, you don't need it.*





Ignore All Speed Warnings

Diamond's Monster 3DII featuring 3Dfx's Voodoo^2 accelerator – a Bit Burnin', Pixel-Crushing, Polygon Packin', Hi-Res Full-Screen Speed Demon.

- Clock over 60 frames per second
- Floor it with the MEGA-Monster dual card feature for over 100 fps and 1024x768 gaming
- 8MB or 12MB configurations
- FREE games! Including the Limited Edition Star Wars Game Pack, Heavy Gear™, TombRaider II™ Special Edition, and more.

3Dfx Interactive

DIAMOND MULTIMEDIA

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Product Information Number 371

3Dfx interactive
VOODOO2

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Hype-Speed **Drives**

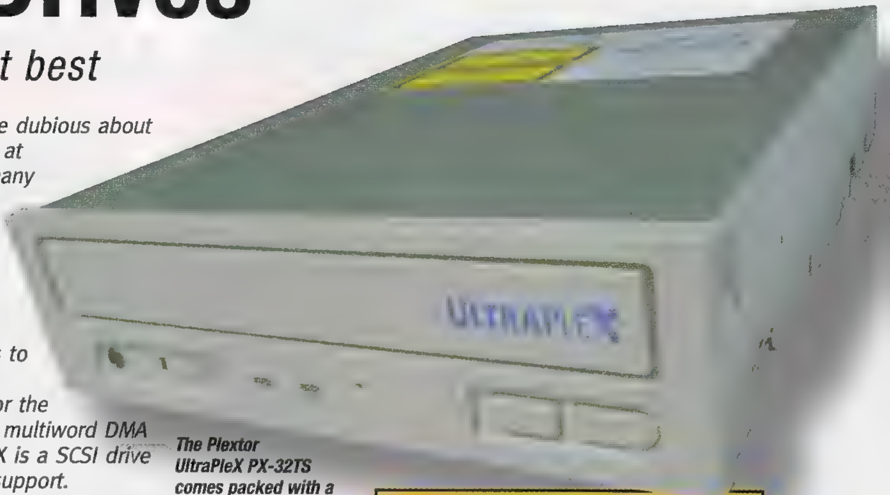
32x CD-ROM drives hit 24x at best

Still reeling from the 24x CD-ROM drive fiasco, we were dubious about 32x drives. Come on, a CD-ROM that can transfer data at 4.8MB/sec!? Some 32x drives have surprised us. But many of these drives suffer the same affliction that plagued the 24x drives—the inability to read anything other than perfect discs at high speeds.

Unlike the 24x drives, all the current 32x drives we've seen utilize Constant Angular Velocity (CAV) architecture. CAV drives spin the disc at a constant speed, so the data rate increases as the pickup moves to the outer edges of the disc.

All the drives reviewed here are IDE/ATAPI except for the Plextor and support EIDE (Enhanced IDE) PIO mode 4, multiword DMA mode 2, and Ultra DMA/33 mode. The Plextor UltraPleX is a SCSI drive that requires an UltraSCSI host adapter for full-speed support.

—Sean Cleveland



The Plextor UltraPleX PX-32TS comes packed with a 152K buffer.

Plextor **UltraPleX** PX-32TS 32x **Max/14x** Min **SCSI CAV**

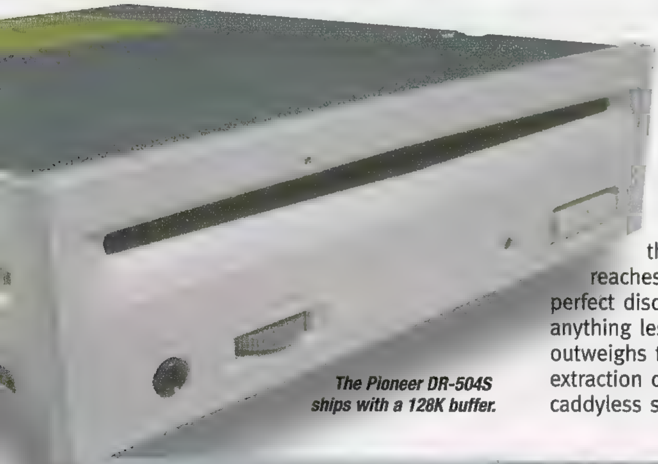
boot KICK ASS! PRODUCT

The UltraPleX endured our tests with aplomb and emerged victorious. This is truly a kick-ass drive! True to specs, the drive transfers at 14x minimum, with maximum speeds of 32x. And although it has problems with imperfect discs as well, it at least transfers data at the speeds advertised. Hell, it hit speeds of 5,556K/sec with the gold disc we fed it! That's 37x! We tested the UltraPleX with the Adaptec AHA-2940AU SCSI host adapter that came with it, and setting them up was Plug-n-Play. Of course, set up is easy with features such as SCSI ID auto selection and auto termination. A thick-ass manual chock-full of information and support, as well as some very powerful utilities also come bundled. Tray-load or caddy-load designs are both available. If you're looking for speed, then you need this drive.

SUPPORT Redbook | Yellowbook | ISO 9660 | High Sierra (Logical Formats) | CD-UDF (variable packets) | CD-ROM Mode 1 | CD-ROM XA Mode 2 (Form 1, 2) | CD-DA | CD-Extra | Video CD | CD-I | Multisession Mode 1 and 2 | Rockridge | PhotoCD | CD-Extra (CD-Plus) | Enhanced CD | CD+G | CD-Midi | CD-R | CD-RW

Price $249 ($359 with Adaptec 2940UE SCSI card)
Company Plextor
Phone 800.475.3986
URL www.plextor.com/ultra.htm

boot verdict 10



The Pioneer DR-504S ships with a 128K buffer.

Pioneer DR-504S **32x** Max **ATAPI**

The Pioneer uses a low-vibration mechanism, with terrible results. Failing to shield the spindle causes uneven disc vibration, so the DR-504S slows down dramatically when reading the outside tracks. And while it reaches outstanding 35x speeds with perfect discs, it reads at only 18x with anything less. It's a shame that this outweighs the drive's excellent digital extraction capabilities and slick trayless, caddyless slot-in loading mechanism. The DR-504S performed admirably, delivering the highest burst rates and the fastest random-access seeks despite its vibration problems. The drive is also bundled in Hi-Val's 32x CD-ROM kit.

SUPPORT Redbook | Yellowbook | ISO 9660 | CD-ROM Mode 1 | CD-ROM XA Mode 2 (Form 1, 2) | CD-DA | CD Extra | Video CD | CD-I | CD-R | CD-RW

Price $129
Company Pioneer
Phone 800.444.6786
URL www.pioneerusa.com

boot verdict 6

Doin' the Shimmy

Each manufacturer has its own proprietary way of minimizing vibration at high speeds. Some do it well. Those that don't have drives whose spindle must slow down so the drive head can read the data. When this happens, the overall speed on the outside track is affected. These scores help determine each drive's bootVerdict.

	Asus CD-S340	Pioneer DR-504S	Plextor UltraPleX	Teac CD-532E	Toshiba XM-6202B
Data Throughput, Outside Track, nearly perfect (gold) disc (K/sec)	2,777	5,213	5,556	4,873	4560
Data Throughput, Outside Track, imperfect disc (K/sec)	2,671	2,664	4,847	2,955	4603

All drives were tested with Adaptec's 2940UW SCSI Host Adapter on a Toshiba Infinia 7260

Toshiba XM-6202B 32x Max ATAPI

Toshiba has no problem with spindle vibration. Uneven discs spun at high speeds yielded on-par performance with perfect discs. We did see one problem: While testing with CD-Tach, any subsequent test performed after the initial test yielded even worse results. The disc needed to be ejected to get scores that reflected the original ones. The drive was a solid performer on every level and supports almost every type of disc. Its audio extraction was acceptable. It has the fastest full-stroke seek of any drive (even the UltraPleX), including one of the fastest random-access seeks. The XM-6202B certainly is no slacker. If you're a dedicated IDE/ATAPI CD-ROM fan, this is the drive to get.

The Toshiba XM-6202B delivers with a 256K buffer.

SUPPORT Redbook | Yellowbook | ISO 9660 | High Sierra (Logical Formats) | CD-ROM Mode 1 | CD-ROM XA Mode 2 (Form 1, 2) | CD-I Bridge (PhotoCD, VideoCD) | CD-I | CD-I Ready | CD-G | Multisession | CD Extra | CD-R | CD-RW

boot verdict 8

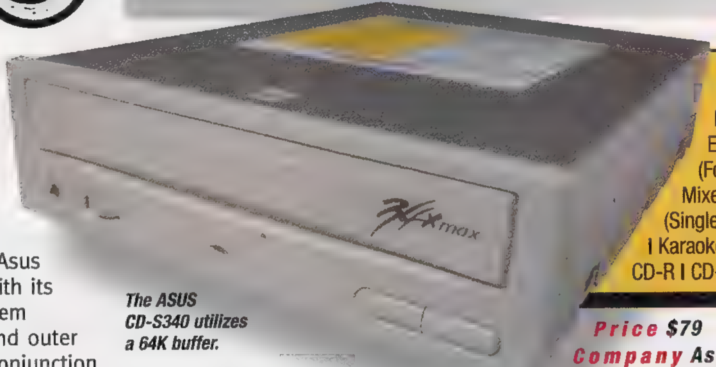
Price $129
Company Toshiba
Phone 714.457.0777
URL www.toshiba.com/taisdpd/xm6202.htm

Doin' the Numbers

We tested these drives with the Supplemental Cache Size set to small with No read-ahead (under the "Optimize Access Pattern for" option). These are found in the System portion of the control panel under the Optimization tab. Turning off supplemental cache and read-ahead gives an accurate picture of the drive's real performance. We recommend leaving the Supplemental Cache Size set to small for higher throughputs and the Optimize Access Pattern option set to Quad-speed or higher. And it is imperative to run the IDE/ATAPI versions with DMA turned on.

	Asus CD-S340	Pioneer DR-504S	Plextor UltraPleX	Teac CD-532E	Toshiba XM-6202B
Interface	CAV	CAV	CAV	CAV	CAV
Drive Type	ATAPI	ATAPI	SCSI	ATAPI	ATAPI
CD Tach Digital Extraction Speed	4.3x	12x	23.6x	15.4x	10.7x
CD Tach Digital Extraction Throughput (K/sec)	732	2,068	4,065	2,652	1,849
Time to copy bootDisc 20 to a hard drive – 651MB (mins)	8:40	7:33	7:07	7:31	7:24
Read 16K Outside Tracks (K/sec)	2,671	2,664	4,847	2,955	4,603
Read 16K Center Tracks (K/sec)	2,630	3,499	3,755	3,790	3,588
Read 16K Inside Tracks (K/sec)	2,339	2,014	2,170	2,188	2,072
Full Stroke Seek (ms)	133	163	135	294	119
Random Access Seek (ms)	76	75	83	99	77
CPU Utilization @ 2x (300 K/sec)	10	5	5	10	7
CPU Utilization @ 4x (600 K/sec)	20	10	9	19	12
CPU Utilization @ 6x (900 K/sec)	32	13	13	21	17
CPU Utilization @ 8x (1,200 K/sec)	40	18	19	30	22
CPU Utilization @ 12x (1,800 K/sec)	58	25	26	38	34
CPU Utilization @ 24x (2,400 K/sec)	Failed	Failed	48	Failed	63
2K Burst (K/sec)	1,950	2,811	2,643	3,161	2,420
8K Burst (K/sec)	2,706	5,678	5,502	4,880	4,389
16K Burst (K/sec)	2,886	6,828	6,529	5,610	5,165
CD Tach Drive Speed	16.6x	17.4x	21.0x	19.0x	20.0x

All drives were tested with Adaptec's 2940UW SCSI Host Adapter on a Toshiba Infinia 7260.



The ASUS CD-S340 utilizes a 64K buffer.

Asus CD-S340 34x Max ATAPI

Asus, maker of motherboards, enters the CD-ROM fray with its 34x drive. Problem is, it only performs at half that. Our testing placed it dead last on all fronts. Asus tackles spindle-motor vibration with its Double Dynamic Suspension System (DDSS), which applies an inner and outer layer of anti-vibration rubber in conjunction with a dynamic damper. It must work, because the drive spins a disc at a constant speed of around 17x. Too bad it's not the 34x Asus advertises. And this drive is loud. The drive is both inexpensive and cheap. Need we say more?

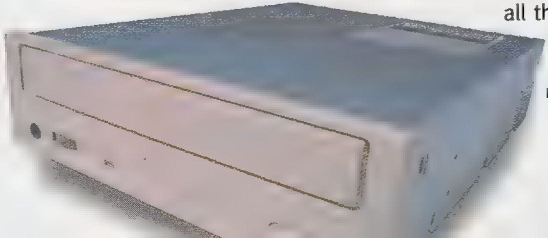
SUPPORT Redbook | Yellowbook | ISO 9660 | CD-ROM (Mode 1, 2) | CD Extra | CD-ROM XA Mode 2 (Form 1, 2) | VideoCD | CD-I | Mixed Mode | PhotoCD (Single and Multisession) | Karaoke CD | I-Trax CD | CD-R | CD-RW

boot verdict 4

Price $79
Company Asus
Phone 510.739.3777
URL www.asus.com/products/specs/cdrom.asp

Teac CD-532E 32x Max ATAPI

This ATAPI 32x drive performed almost on par with the Pioneer drive. Its drive spindle suffers from vibrations emanating from uneven discs, and even "perfect disc" reads fell short of the Pioneer's speeds overall. The Teac delivered the slowest random-access and full-stroke seek times of all the drives. Its digital audio extraction and playback abilities are top-notch, though, and will satisfy the most die-hard audiophiles—at least those craving an ATAPI 32x drive. But the UltraPleX still beat it out. Teac's UltraSCSI version of the CD-532E (with a 512K buffer) may not suffer the tribulations of its ATAPI brethren. Software includes an audio player for Windows that comes equipped with all the options. It's a useful utility that complements its impressive digital audio capabilities.



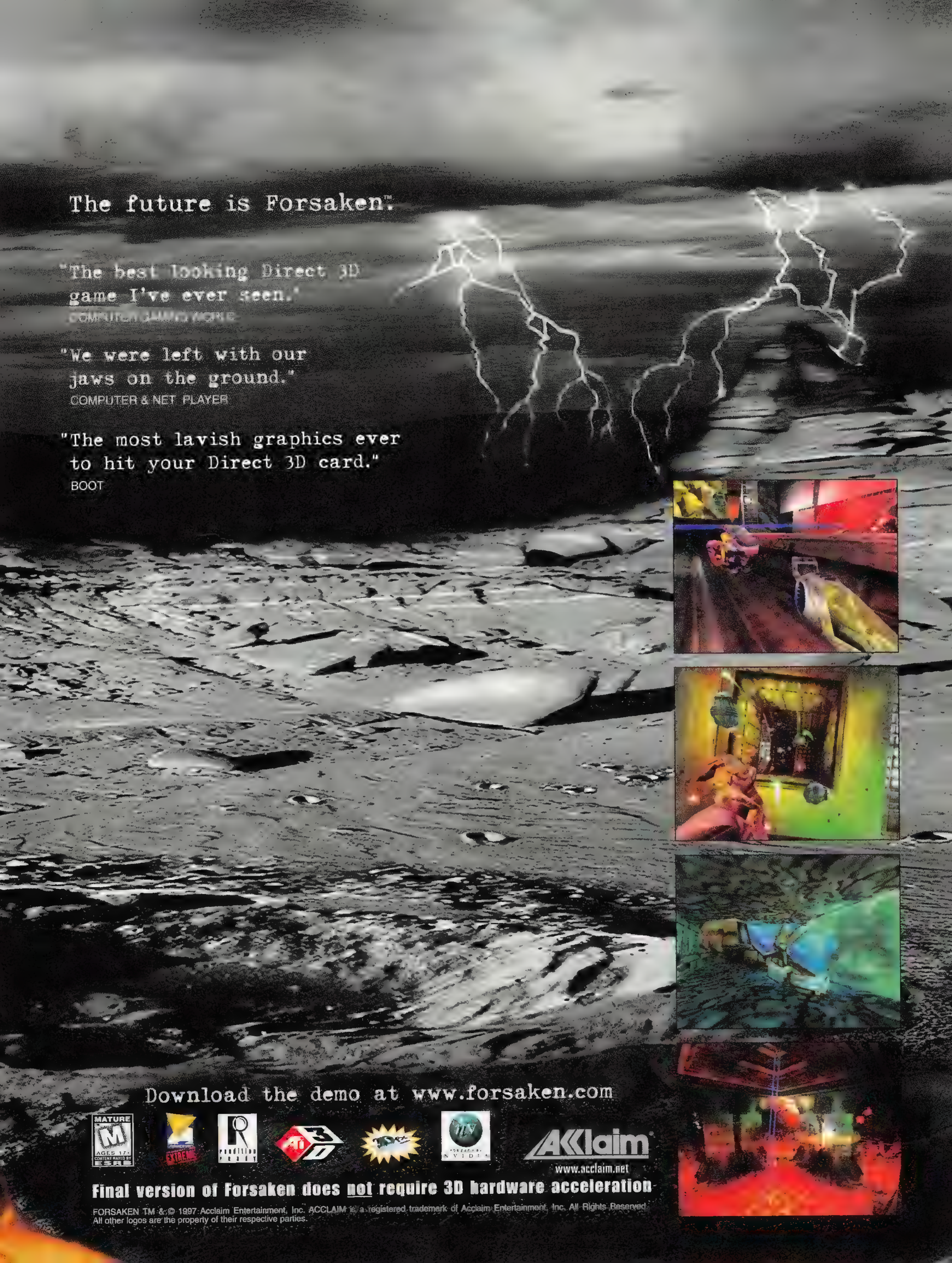
The Teac CD-532E comes standard with a 128K buffer.

SUPPORT Redbook | Yellowbook | ISO 9660 | CD-ROM Mode 1 | CD-ROM XA Mode 2 (Form 1, 2) | CD-I | Multisession PhotoCD | VideoCD | I-Trax CD

boot verdict 6

Price $129
Company Teac
Phone 213.726.0303
URL www.teac.com/dsp/dsp.htm

FORSAKEN



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Descent To **Undermountain**

Something stinky this way comes

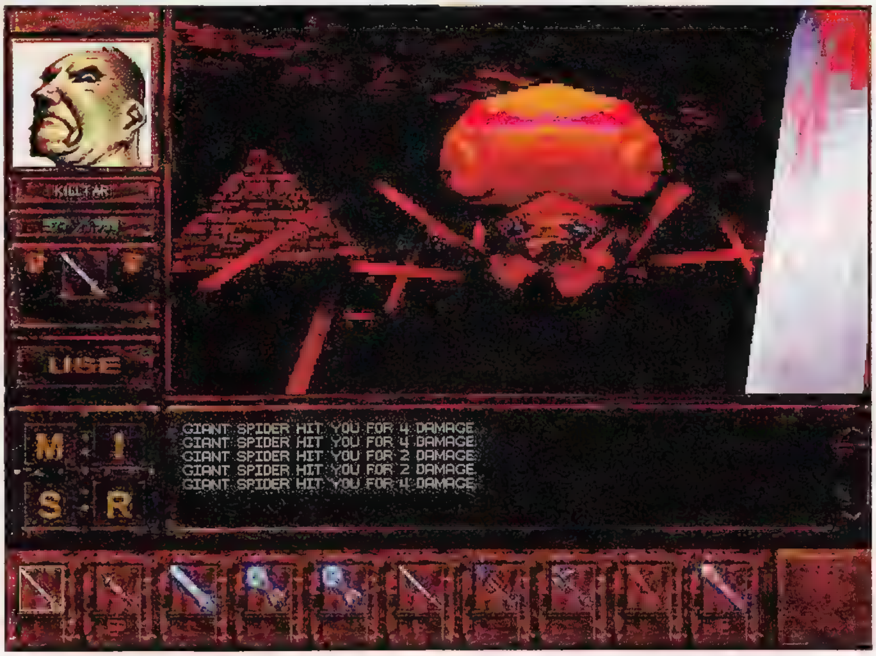
CHECKLIST

Descent To Undermountain
Version: 1.1
Max Res/Color 640x480/16-bit
MS-DOS Compatible

This marriage of the venerable Descent engine with official Dungeons & Dragons rules and mythos should have spawned a fertile battlefield for RPG fanatics to bust some undead heads, right? Wrong. Cursed with some of the worst performance and graphics ever seen in a polygon-based first-person game, *Descent To Undermountain*'s single-player mix of real-time action and role-playing adventuring is all for naught.

The dungeon terrain's texture palettes run the gamut from brown to really dark brown, with occasional mocha spurts to keep things interesting. Despite claims of 300+ megs of textures, *DTU*'s pixelated 64x64 textures border on the visually criminal.

To make matters worse, this SVGA sludge is delivered at single-digit frame rates on all but the most burly CPU and DOS videocard combos. Simple 3D acceleration could have easily alleviated the fps constipation, but your texel-tickling silicon will be collecting dust; *DTU* only supports a software renderer—even at 640x480. The Descent II engine has tasted almost every API known to man, including native S3, Rendition, 3Dfx, and the all-encompassing D3D. Given this, the lack of any 3D acceleration is straight-up unacceptable!



```
GIANT SPIDER HIT YOU FOR 4 DAMAGE
GIANT SPIDER HIT YOU FOR 4 DAMAGE
GIANT SPIDER HIT YOU FOR 2 DAMAGE
GIANT SPIDER HIT YOU FOR 2 DAMAGE
GIANT SPIDER HIT YOU FOR 4 DAMAGE
```

Deep within the dungeons of Undermountain, a giant spider hinders your adventure—note the point-sampled texture on the weapons to your right. Ugh.

The most terrifying thing in this dungeon are the weak 2D spites lurking around every corner, from transparent brushes to cheesy three-frame sparkles supposedly representing magical effects. And don't come looking for the delicious colored-light effects of *Quake II* or *Forsaken* here—light-sourcing is relegated to the occasional localized sprite torch, lava lake, and fireball. Even the semitransparent stained glass and waterfalls (via animated textures) look dated in this age of alpha-blending and particle effects.

The nasty, rambunctious hordes of the *Hexen* and *Quake* series are genuinely scary—*DTU*'s low-polygon-count minions look downright lame. The repetitious motion of some 250 undead hordes, dragons, and goblins masks the purported 7,800 frames of animation. And silly collision detection makes all objects feel like they're floating.

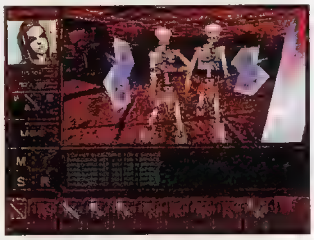
Along with this sloppiness comes equally sloppy melee weapon combat and gameplay. Lag is the word of the day. Hell, we won't even go into the bunk-ass intro and static NPC interaction screens you'll be forced to endure if you decide to traverse this rancid realm.

Had it come out when first promised years ago, *Descent To Undermountain* may have had a fighting chance. But RPG mavens lusting for real first-person action should turn to the *Ultima Underworld* series for their fill of moody graphics, excellent NPC interaction, and awesome storytelling—just a few of the many key elements totally lacking in *DTU*. While 3D acceleration certainly would have helped, *Descent To Undermountain* was dead before it hit the shelves.

Bury this thing before it starts to stink.

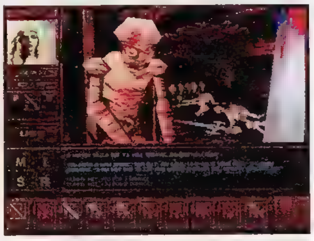
—Andrew Sanchez

Challenging polygon AD&D beasties may sound great on paper, but in DTU, it fails.



Dual skeletons wielding battle-axes await your cold steel.

Hey—it's an undead party! Where's the beer?



You won't want your mummy after a visit to DTU.

Price $50
Company Interplay
Phone 800.454.6064
URL www.dragonplay.com

boot verdict
2

CD-ROM Changers

Gimme a little of that stop-swappin' beat

People used to complain of "floppy elbow"—pain ensuing from repeatedly swapping floppies while installing a single app. CD-ROMs alleviated the problem temporarily, only now we're swapping CDs instead of floppies. If your elbow's starting to ache and you're tired of waiting for DVD, look into a CD-ROM changer. Just a year ago they were slow and buggy as hell. Today they're shaking off the eccentricities and stigma of the bastard child.

You won't have instant access to all your discs. Loading and swapping between multiple discs takes time. And different SCSI cards treat changers differently.

—Sean Cleveland

24X
MAGAZINE EJECT
PIONEER
POWER
BUSY
PHONES LEVEL
LaserMemory

The 24x Pioneer DRM-6324X uses a six-disc cartridge and supports CD-ROM Mode 1 and 2, CD-Audio, and XA disk standards. All these discs must be inserted face down because the laser is mounted upside down to prevent dust from settling on the lens.

JES MZFO-003

A pair of five-disc Nakamichi MJ-5.16si CD-ROM changers make up this external SCSI unit from JES. And this 16x drive performs as touted.

The caching scheme on the JES is better than on the Pioneer, but rebooting still requires rereading each disc. Still, loading was faster, with all the disks requiring less than a minute. Of course, the difference can be credited to the drive's dual-five make-up (at almost twice the cost). Bottomline: a full 10 seconds was required to read a single disc.

On the MZFO-003, an LED next to each drive button indicates which bays are full. The drive supports CD-ROM MOde 1 and 2, CD-DA, XA, PhotoCD (Multisession), CD-1, Video CD, and CD-Extra.

Among the utilities included, one lists disc information and adds the ability to eject each bay. The other is a CD player for listening to audio discs. Again, additional software and smarter drivers would make this JES kick some serious ass.

Between these two, we'd go with the JES. More discs, faster swapping, and a smart loading mechanism make it more attractive. Smarter caching, even at this speed, would've made it a no-brainer.

***Price** $781 ($981 with Adaptec 2940 Host Adapter)*
***Company** JES*
***Phone** 800.482.1866*
***URL** www.jescdrom.com/nakamichi.html*

boot verdict 8

Pioneer DRM-6324X

Pioneer, true to its name, was one of the first in this market, and its most recent offering is a six-disc cartridge-based changer with a 24x max read speed.

But it isn't really 24x.

In fact, it's more like 16x. And this isn't the DRM-6324x's only fault. Poor caching algorithms force Windows to reload and reread all the discs in the drive each time you boot (either in the Explorer or when a piece of software does a drive search). And even once cached, a disc must be loaded just to view its contents. It takes over a minute to read six bootDiscs. But the drive is smart enough not to reread every disc when a new one is added, which was a problem with older models. Switching discs takes 15 seconds on average. A utility letting you set the cache size and how deeply you want to cache would prevent the drive from swapping simply to view its contents.

A changer that lived up to its speed promises and dealt with the challenges of disc swapping would do the proud Pioneer name much better.

***Price** $495*
***Company** Pioneer*
***Phone** 800.444.6784*
***URL** www.pioneerusa.com/cd_cdrom.html#changers*

boot verdict 5

Dare to Compare

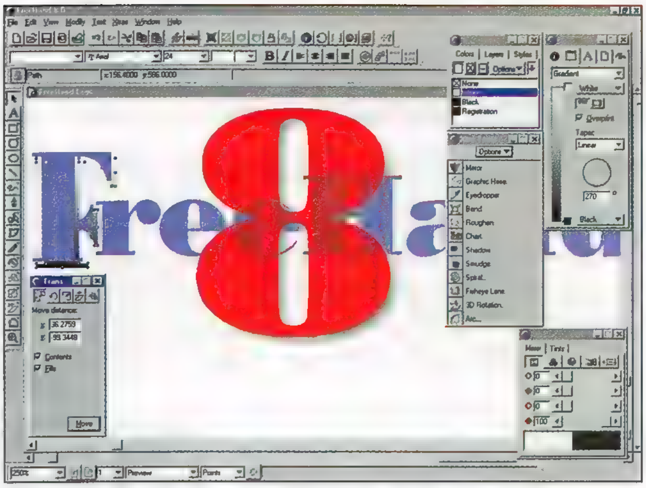
	Pioneer DRM-6324X	JES MZFO-003
Interface	External SCSI	External SCSI
Cache Buffer	128K	256K
Drive Type	CAV/CLV	CAV
Timed Tests (min:sec)		
Time to read discs in Explorer	1:18	0:55
Time to change discs	0:15	0:10
Time to copy		
Wing Commander IV – 579MB	3:49	4:35
CD Tach Read Tests		
Read 16K Outside Tracks (K/sec)	1,794	2,409
Read 16K Center Tracks (K/sec)	3,189	2,501
Read 16K Inside Tracks (K/sec)	1,926	1,582
CPU Utilization		
@2x (300K/sec)	1%	1%
@4x (600K/sec)	2%	2%
@6x (900K/sec)	3%	3%
@8x (1,200K/sec)	4%	5%
@12x (1,800K/sec)	6%	6%
@16x (2,400K/sec)	Failed	12%
Full Stroke Seek (ms)	193	366
Random Access Seek (ms)	84	122
2K Burst (K/sec)	15,297	14,205
8K Burst (K/sec)	63,215	61,983
16K Burst (K/sec)	75,485	79,878
1CD Tach Drive Speed	15.5x	13.5x

All drives were tested with Adaptec's 2940UW SCSI Host Adapter on a Toshiba Infinia 7260.

FreeHand 8

It's Grrrrr8!

boot KICK ASS! PRODUCT



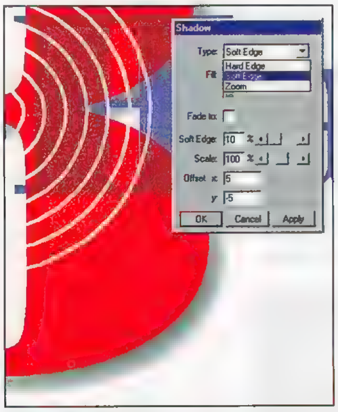
The streamlined interface in FreeHand 8 *showcases the many powerful new tools that take this graphics software beyond all competitors.*

With version 8, *FreeHand* finally and definitively surpasses Adobe's long-dominant *Illustrator* as the king of vector-based graphics by looking to the best DTP apps for inspiration. Powerful new tools, perfect WYSIWYG output, and an incredibly flexible interface that allows you to work any way you want, all combine to make 8 great.

The sexiest new tools under *FreeHand*'s belt are the Lenses, which filter images. Most impressive of these is a Transparency Lens that applies a definable translucence to vector objects, the only caveat being that type must be converted to outlines before applying the Lens. This effect was first seen in a cruder form with *CorelDraw*, but *FreeHand*'s implementation is far superior and integrated, and *Illustrator* ain't got nothing like it.

Other lenses include effects that invert, lighten, darken, and saturate or desaturate colors, which are usually associated with raster-based editors such as *Photoshop*. A Magnify Lens enlarges a portion of the illustration you want to spotlight.

Artists familiar with *Painter* will recognize *FreeHand*'s similarly named (and functioning) Graphic Hose for spraying randomly cycling patterns of any design. This works great for seeing the forest for the trees that make it up.



Shadow

Type: Soft Edge

Fill: Hard Edge / Soft Edge / Zoom

Fade to: ☐

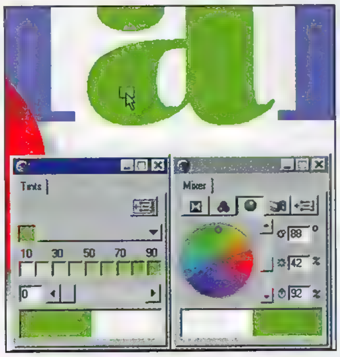
Soft Edge: 10 %

Scale: 100 %

Offset x: 5

y: -5

Now natural soft-edged shadows are a simple Xtra away.



Even when the two color tabs in the floating Color Mixer palette are torn asunder, assigning colors in FreeHand 8 *is a simple drag-and-drop affair.*

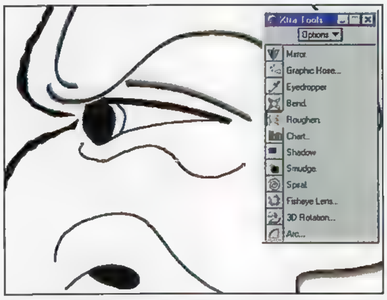
And taking *Illustrator*'s transform palette to the next level, double clicking an object in *FreeHand* allows you to spin or scale it from a selectable origin point. *FreeHand* can now fill open paths like its primary competitor. And *FreeHand*'s FreeForm tool makes your beziers pliable like putty in your hands.

From *QuarkXpress,* this latest version of *FreeHand* borrows the Collect For Output option and even takes it a step further by including fonts in the process. Also present is a Picture Usage dialogue for tracking imported images.

On the subject of importing, it should be noted that *FreeHand* imports and exports nearly every file format known to PCdom. It even has native support for TIFFs. Noteworthy exports include Adobe *Acrobat 3.0*, *Quark EPS*, and *Desktop Color Separation 2.0*. Check Macromedia's web site for a complete list.

If you want to convert your vector images into an anti-aliased raster format, *FreeHand* now does it within the program and with a much lower memory overhead than *Illustrator*.

If all these features make you think of your favorite DTP software and you're having a hard time getting the keyboard commands straight, *FreeHand* has you covered. All your favorite commands can be re-keyed to mimic the combo you're most comfortable with, including presets that mimic *Xpress*, *CorelDraw*, and *Illustrator*. And when you're not Cntrling your way through the program, *FreeHand*'s bevy of dockable floating palettes can be combined or separated to suit your needs. The hearty toolbar atop the window can be customized to include your most frequent commands. Handy.



FreeHand 8 *can be expanded via the Xtra plug-ins that reduce even the more complex tasks to a few simple clicks.*

Increasingly, designers are asked to create work for the online realm, and *FreeHand* steps up to the challenge (albeit with mixed results). While rudimentary features such as embedded URLs are included, Macromedia has included support for its exodus-from-the-CD-ROM product, *Flash 2*, with the new version of *FreeHand*. Now, your images can be animated and exported as *Flash*'s SWF format. From there they can be posted to a web site or brought into the company's *Flash 2* editor for further refinement. (The *Flash 2* program is available, along with *Insta.HTML 2*, in the *Design In Motion* suite for $100 more.) From there the animation can be converted to an animated GIF or QuickTime movie.

Problem is that *Flash* is yet another plug-in (although the company's Universal Media Initiative would allow playback via Java as well), and we all know how well Shockwave went over. Kerplunk! And a minor quibble is the fact that *Flash* doesn't work with *FreeHand*'s transparency feature.

Still, when these are the biggest caveats, you know you have a mighty solid product on your creative hands.

—Brad Dosland

Price $399 ($499 with Design In Motion suite)
Company Macromedia
Phone 415.252.2000
URL www.macromedia.com

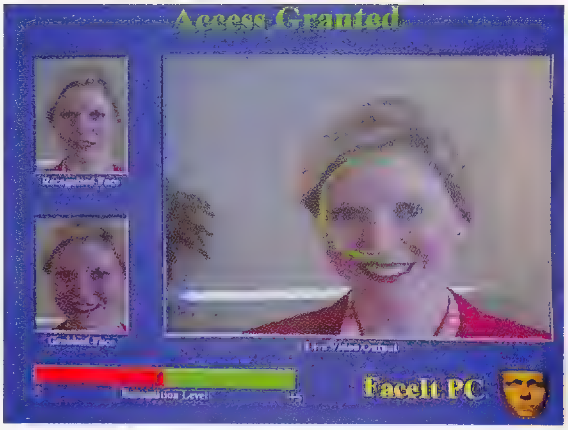
boot verdict 9

Biometrics Cometh

Getting the recognition you deserve

Biometrics is one of the hottest technological developments to come from government research; it's now publicly available and very inexpensive. You've seen the science-fiction films in which high-security facilities use verification techniques such as retinal scans, fingerprints, keycards, and password schemes. In present fact, several identification methods exist. Here we look at three software packages that use your face and your voice.

—Daevid Vincent



FaceIt *recognition is fast and smart, and it can even track from a distance.*

FaceIt PC

TRY IT ON THE DISC

FaceIt is a continuous tracking system and therefore does not require a trigger, such as a keystroke or mouse click, or that the user stand in front of a flat background during facial scans. *FaceIt* logs all accesses and failures to a detailed audit report that time-stamps all faces that attempt to use the system and can be FTP'd to a web site for remote perusal. The system is secured after a specified time limit is reached. It can optionally detect spoofing attempts using photos or masks by testing for "liveliness": blinking or smiling. Personal features such as glasses, hairstyle and color, or facial hair are not factors in the algorithm.

As a user is recognized, that info is added to the database, increasing the detection speed for the next time. Three levels of security allow for a maximum error rate of 1/10,000.

The software comes with many useful utilities. Text-to-speech enabled, it can talk upon recognition of a user. A *FaceIt* cipher program allows for the 56-bit key DES encryption of private files, and of course uses the user's face to en/decrypt. It can also act as an answering machine, prompting unauthorized users with a customizable AVI to leave a text message that can be stored locally or e-mailed along with a snapshot of the person. A master password override is provided for those who don't quite trust their system yet. To encourage the development of applications for face recognition, Visionics has made available an SDK that allows the rapid incorporation of the *FaceIt* technology into any custom product.

Price ***$150***
Company ***Visionics Corp***
Phone ***201.332.9213***
URL ***www.faceit.com***

boot verdict 8

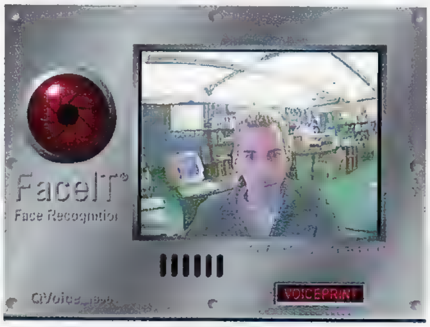
Star Trek DS9 Voice Print Security

TRY IT ON THE DISC

Voice Print takes the face-recognition technology of *FaceIt* one step further—it adds voice. The beauty of a multi-biometric system is that each threshold can be lowered because the other systems compensate. Thus faster recognition can occur because there is more tolerance for error in any given part. Just as face recognition works independently of glasses, facial hair, and hair styles, so too does voice recognition. It doesn't matter what you say, but how you say it. "Hey diddle diddle" verified us just as easily as "Computer, verify me."

The program is robust, with features geared toward both parental control and company-wide implementation. For the first, flexible time restrictions can be placed on any icon (for blocking out game playing on school nights), and for the latter such features as disabling the installation of new programs to the start menu curb the use of personal programs on company machines.

Eleven "gatekeeper" screens incorporate any standard AVI and WAV file, or you can choose from the several included. Multiple levels of security are definable, from voice and face detection levels to which protection schemes are actually required for access: voice, face, or PIN. For protecting folders and icons, the primary dataset is automatically de/encrypted upon boot/shutdown and user datasets are done upon request. These encrypted files are moved and hidden to prevent hacking.



A variety of gatekeeper motifs are available; this one is the most "normal" looking for those who aren't Trekkers.

The *Star Trek* motif made it difficult to take the system seriously, but the ability to customize reduced that stigma. The voice recognition was quick and accurate. A password-override key is available as well. One handy feature is a user-defined hotkey to lock the machine instantly. Using "New DES Encryption," a master backdoor key is provided and stored with QVoice upon registration (in case you ever forget it, or you die and your company needs to access your data), which is required within 45 days or the program ceases to work! In the near future, QVoice intends to add a third biometric: fingerprint technology.

Price ***$80 Voice & Face Print; $34 add-on packs; $60 Voice Print only***
Company ***Visionics Corp***
Phone ***973.786.6878***
URL ***www.qvtrek.com***

boot verdict 9

How Does It Work?

Both these products use the FaceIt *face-recognition engine, a proprietary technique based on Local Feature Analysis (LFA), and not the 2D/3D models that Eigenfaces or neural technology use. LFA is a statistical pattern representation derived from an ensemble of patterns that make up the unique set of local building blocks that best represent new instances of these patterns. For example, starting with an ensemble of images, LFA derives the set of local features optimal for representing any new face encountered. Equipped with these universal facial building blocks,* FaceIt *automatically breaks down a face into its component features—what defines your identity is not only which building blocks are used but also the precise manner in which they are used to represent your face.*

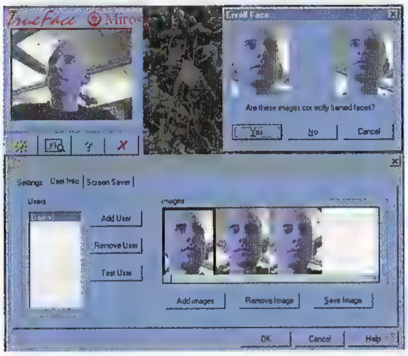
Miros's TrueFace PC/95 **1.01**

TRY IT ON THE DISC

GET IT FROM bootNet

If *TrueFace PC/95* were the only biometric software, it might've ranked higher, but having tried what's available, we're hard pressed to give it a more generous verdict.

You can't disable the program once installed—bar uninstalling—and there's no hotkey to initiate the program. Nor is a password prompt available to override the recognition until the third attempt fails. The program forces itself into the Windows directory, and all settings are accessed via a control panel icon.



Are these images correctly framed faces?

***Miros's* TrueFace PC/95 *does what it's supposed to, but it lacks the bells and whistles of* FaceIt PC *and* Voice Print.**

Verification is quick but cumbersome—first you're prompted for a username, then you must click on a left and right image of your face to verify that the picture taken is accurate. Unfortunately, the process is also security flawed: the username prompt defaults to the last user entered. And while the last unsuccessful attempt image is stored (and only that image), this can be easily erased by placing anything in front of the camera to clear it.

Using the default threshold setting of 5.0 (the maximum is 10) and three images, an intruder gained access after two failed attempts. Increasing the settings to 8.0 and five images failed to verify us, but adding two images to the database greatly increased our odds of being verified immediately.

Price *$60 FTP; $100 boxed*
Company *Miros Inc.*
Phone *781.235.0330*
URL *www.miros.com*

boot verdict 5

Axis NetEye **200**

I spy with my bionic eye

This stand-alone camera includes the base for easy mounting and ample cable to stretch long distances.

The NetEye 200 is a quick and easy solution for monitoring a remote locale or serving up live video to the web. Installation is as simple as mounting the camera, plugging in the power and RJ-45 10BaseT cables, and assigning an IP number to its Ethernet address using ARP (you'll need an extra dedicated IP address or external modem). The camera is then configured using its internal HTTP server via a web browser.

Several irregular resolutions are supported, from 704x576 at full size to 176x144 at half. Any feature you'd expect from a digital camera is supported, such as mirroring, cropping, rotation, dark detect, three compression levels, and even a date/time stamp. If you don't want anonymous-user access, you can add multiple accounts that require a username and password combo to see what the camera sees. Additionally, BOOTP, RARP, ICMP, TCP, and FTP are implemented.

For those without a spare IP address, a 9-pin RS-232 port is available for direct Z-Modem protocol download via `sz`. Images can be retrieved using standard, server-push, and Java image feeds with live examples included in the unit. A C program is included for Unix-based web server machines to compile for the timed automatic FTP of images. This is especially useful, because the camera was not designed to serve more than a handful of image requests itself.

While the Axis NetEye 200 is robust, ultimately its high price makes the $595 Microplex NetworkEye/270 (*boot* 15) a more economical option.

—Daevid Vincent

Price *$1,000*
Company *Axis Communications*
Phone *800.444.AXIS*
URL *www.axisinc.com*

boot verdict 7

Eye**Catcher**

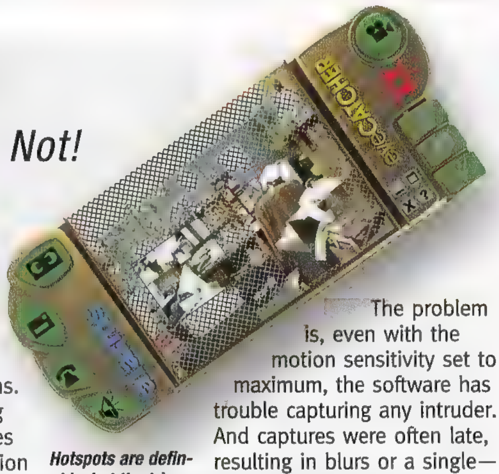
Catcher in the Eye: Not!

TRY IT ON THE DISC

A good idea that somehow went awry, *EyeCatcher* video surveillance software logs movement detected when user-defined hot spots are violated, activating up to four alarms.

The video alarm begins recording AVI and WAV files (into separate files for some reason). Various compression settings are supported to help reduce consumed disk space, which can be limited via a %-free slider. The voice alarm dials a specified number and plays a prerecorded file over the phone. The fax/e-mail alarm uses MAPI to send a selectable number of video frames to a user-defined e-mail address or fax number contained in *Exchange* or *Outlook*'s address book, but there is no LAN support, only modem. The last is simply an audio alarm to alert the intruder he's been detected.

A stealth button minimizes *EyeCatcher* and a password prevents unauthorized tampering.



Hotspots are definable, but the triggering is too slow to even matter.

The problem is, even with the motion sensitivity set to maximum, the software has trouble capturing any intruder. And captures were often late, resulting in blurs or a single—usually unusable—"caught" frame in the whole file. Syncronys spent more time on a pretty GUI and less time optimizing the code that really counts.

—Daevid Vincent

Price *$50*
Company *Syncronys*
Phone *888.999.3800*
URL *www.syncronys.com/eyecatcher*

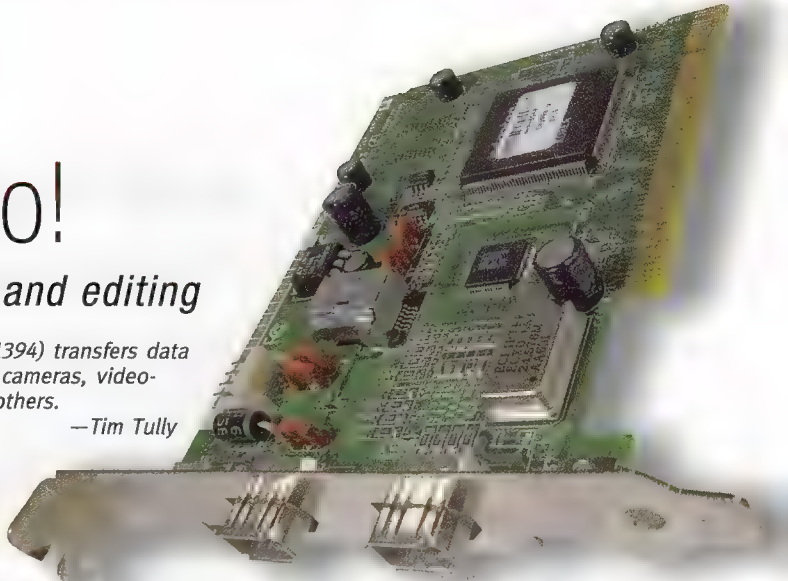
boot verdict 4

Caught on Video!

A new I/O interface for DV capture and editing

Still most widely used in desktop video, FireWire (a.k.a. IEEE 1394) transfers data at 100Mbps and up, and is destined for DVD-ROM, digital still cameras, videoconferencing cameras, printers, scanners, satellite dishes and others.

—Tim Tully



The Spark proved a balky install: a hardware conflict with an Adaptec AHA-2940 SCSI card in a P200 MMX Micron Millennia forced us to use a similar Gateway.

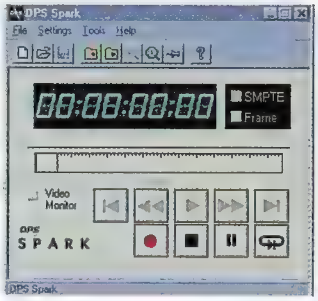
DPS **Spark** 290

Centered on Adaptec's AHA-8940 PCI-bus FireWire board (with one internal and two external 1394 connectors for internal DV drives or other FireWire peripherals) and the DVSoft software codec, the Spark also comes with a proprietary capture utility and Adobe *Premiere 4.2*.

The Spark capture utility is simple but effective, offering navigation controls and a shuttle bar for moving through captured clips. But it doesn't support time-code data from your camcorder.

For editing, import your captured clips into *Premiere* and edit as you would analog video. The Spark has no DSP capabilities and leaves all edits and transitions to the CPU. It only sends the video from the hard disk over FireWire to the camcorder or DV deck, where the device's hardware codec decompresses the video and plays it out in realtime to a video (NTSC) monitor.

When editing is complete, the Spark sends the video to any DV device via FireWire at its original, pristine quality. From there, it can be duped to the video format of your choice. The rendered results are extraordinarily accurate when played either from the hard disk or the camcorder.



The Spark lacks an on-screen preview and software control over the camcorder/deck.

Despite hardware compatibility problems and its no-device-control capture utility, the Spark provided superb video quality and fair functionality.

Price $995
Company Digital Processing Systems
Phone 606.371.5533
URL www.dps.com

boot verdict
7

miroVIDEO **DV 100**

The DV 100 isn't up to miro's or Pinnacle's usual level of quality.

The miro offers no FireWire DV output, so you'll need an additional analog video board to get your edits back to tape. This puts the video through digital/analog conversion and data compression, resulting in loss of image quality. It'll also cost you extra money, PCI slots, and installation time. And the DV 100 won't let you view your video on an NTSC monitor as you edit making accurate editing judgments difficult.

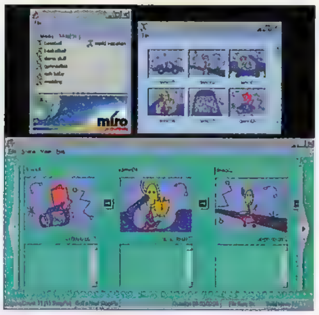
While it's convenient to see the video on the same screen as your capture controls, unfortunately, this is not available. The bundled *StoryTools* capture software doesn't allow it.

StoryTools is supposed to make editing easy for the uninitiated, but we found it otherwise. After shooting, connect your camera to the PC, and *StoryTools* painstakingly scans your entire tape and creates picons using the first frame of every new shot on the tape. You arrange these to reflect the order of clips in your final edit, then *StoryTools* shuttles around the tape to find the clips. You can edit in- and out-points, and the software finally captures them in order.

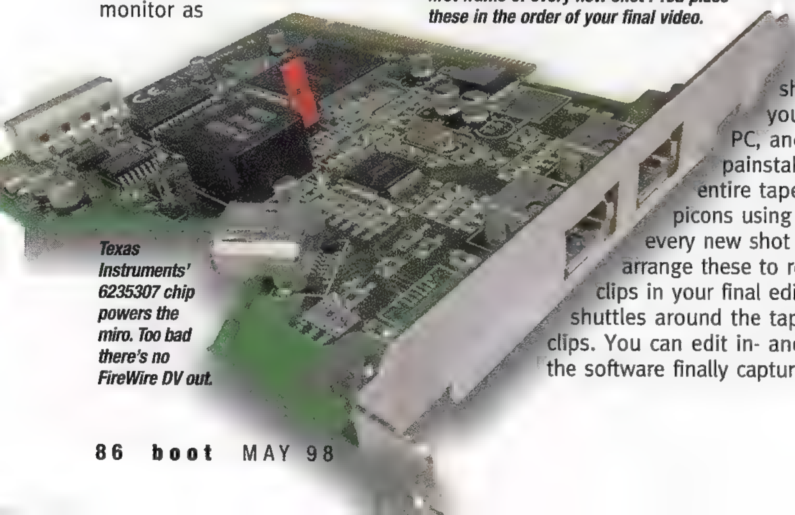
The software proved inept at finding the in- and out-points, overworking our camcorder's transport mercilessly: starting, missing the edit point, stopping, and reversing, over and over. It saved all our clips as a single file, which we then had to cut up in *Premiere*.

The miro card repeatedly stopped and started the tape even while capturing video—three times, for example, in one 30-second clip. And while the Spark Recorder can play a captured clip immediately, *StoryTools* engages in lengthy disk activity, at first unidentified, and then "appending" the clip to the previous clip. All told, it took about 5:04 to grab a 30-second clip.

We were disappointed with the image quality of the DV 100 as well, finding that it altered the color balance of the video it captured. This package is far from the quality miro or Pinnacle usually deliver.



StoryTools scans your tape (no matter how much video is germane to the project at hand) and creates pics of the first frame of every new shot . You place these in the order of your final video.



Texas Instruments' 6235307 chip powers the miro. Too bad there's no FireWire DV out.

Price $599
Company Pinnacle Systems
Phone 888.484.3366
URL www.miro.com

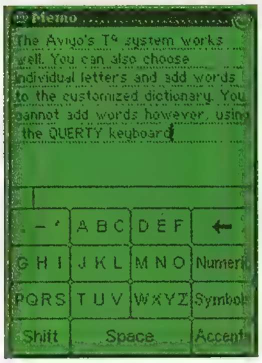
boot verdict
3

Texas Instruments **Avigo**

In a holding pattern

The Avigo looks, acts, and costs about the same as the ubiquitous PDA from Palm Computing. But it isn't a PalmPilot.

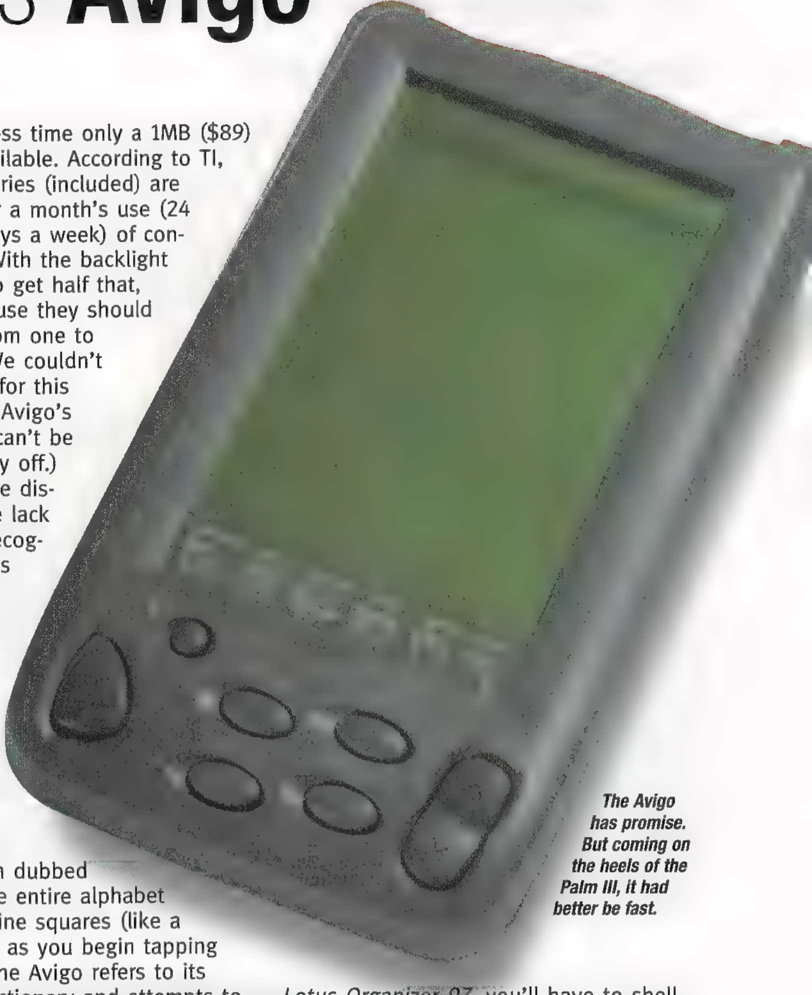
For one thing, it's bigger—both in size and weight—but is still small enough to tote unobtrusively. It's also rugged as hell—the hardened plastic case withstood a drop of more than 3 feet with no ill-effect. Other distinctive features include letter or landscape screen orientation (in select applications), and compared to the PalmPilot, a slightly darker (and more legible) 160x240 display and a brighter electroluminescent backlight. For syncing data to the PC, the Avigo is equipped with two options: a serial docking cradle called PC-Link and an infrared port. Unfortunately, a modem isn't offered, but is being considered for future revs.



The Avigo's T9 system works well. You can also choose ndividual letters and add words to the customized dictionary. You annot add words however, usin the QUERTY keyboard

OK, so it isn't **Graffiti**, *but the inventive T9 text input system worked well, detecting about 98% of the words we were spelling. Scary.*

Inside, the Avigo is powered by TI's custom Z80 processor and flash-based memory—1MB for the programs and 1MB for personal data. The memory expansion socket on the back can upgrade to a total of 64MB, but at press time only a 1MB ($89) upgrade was available. According to TI, the two AA batteries (included) are enough to power a month's use (24 hours a day/7 days a week) of continuous power. With the backlight you'll be lucky to get half that, but with typical use they should last anywhere from one to three months. (We couldn't test this in time for this review since the Avigo's auto-off feature can't be turned completely off.)



The Avigo has promise. But coming on the heels of the Palm III, it had better be fast.

Taggers will be disappointed by the lack of handwriting recognition, like Palm's *Graffiti*, but the Avigo does have a couple of text-input options. The first, a virtual keyboard, is maddening and should be avoided at all costs. But the second, a system dubbed T9, is a gem. The entire alphabet is divided into nine squares (like a phone pad), and as you begin tapping out your word, the Avigo refers to its 67,000+ word dictionary and attempts to "guess" the word, using an algorithm to decode the keystrokes. Alternate words are also displayed, which can then be inserted into the document, or added to the custom dictionary (2,000 words max). Sounds corny, but it works surprisingly well. In fact, the only major anomaly we encountered was the word "Bryan," which was deciphered as the word "Aryan." Doh!

Software is the Avigo's Achilles' heel. Built in apps include a scheduler, doodle pad, expense tracker, and an assortment of calculators. *Lotus Organizer 97* and Puma's *IntelliSync* are also included. But since *IntelliSync* works only with *Lotus Organizer 97*, you'll have to shell out cash for a version that syncs to apps such as *ECCO Pro*, *ACT!*, *Outlook*, or even standard ASCII files. Bah.

The Avigo's cradle folds up, making it easy to transport.

To encourage third-party developers, TI has already released an Avigo API and is planning an SDK in late April for around $50. At press time, four games could be downloaded from TI's web site, but compared to the more than 1,000 applications that can be added to the PalmPilot, the Avigo has a looooong way to go. If more apps—and the modem for e-mail—materialize, the Avigo has potential. Right now, however, it's still in a holding pattern.

—Bryan Del Rizzo

Price *$299*
Company *Texas Instruments*
Phone *800.842.2737*
URL *www.ti.com*

boot verdict 7

To **Serve** and **Protect**

Keeping your PC virus-free

A virus is most simply defined as code that wasn't deliberately installed by you. Traditional antivirus scanners uncover such code by matching up files found on the hard drive with known virus signatures. Today's antivirus offerings strive to protect against infection without interrupting you with the nagging prompts of traditional scans. They load background monitors to check programs as they're executed, scan Internet downloads, and use advanced heuristic techniques to analyze the structure and attributes of suspected files to protect against unknown viruses. But even the most advanced virus protection quickly becomes a worthless annoyance if it intrudes on your PC pleasures.

—Sean Downey

Quarterdeck **ViruSweep**

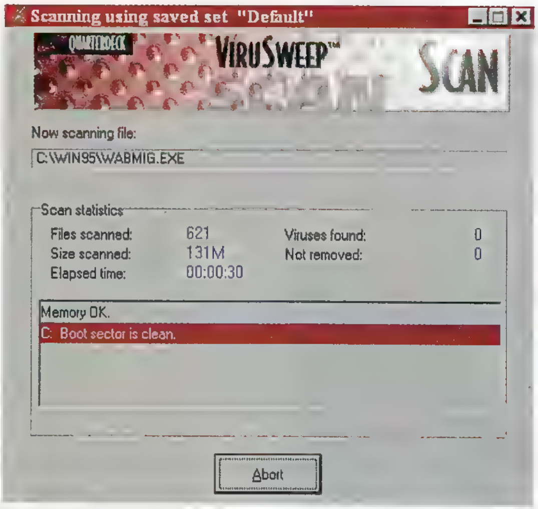
ViruSweep is the quick-and-dirty offering in this roundup. While it performed the fastest scans in our tests, it also missed the most viruses. Out of 40 randomly selected viruses, *ViruSweep* failed to detect 12. While a detection rate of 70% is passing in some circles, it doesn't inspire confidence.

ViruSweep's protection is divided into three modules. *ViruSweep* Watch is loaded at startup to monitor file access and program execution, as well as scan incoming Internet downloads and e-mail attachments. *ViruSweep* Protect guards against suspicious virus-like activities such as illegal name changes and illicit writes to program executables. And *ViruSweep* Scan performs on-demand scanning.

In addition to the standard signature-file scanning, *ViruSweep*'s Smart Scan option uses information such as file size and last-modified date to speed subsequent scans by checking only files that have changed. In our tests, a normal scan of a 2GB hard drive took 51 seconds and a Smart Scan (after the initial run) took only 43 seconds.

Upon detection of viruses, options are limited to clean, delete, or ignore, *ViruSweep* doesn't give an option to rename infected files.

Similar to the other antivirus packages reviewed here, *ViruSweep* verifies the integrity of critical disk areas with saved snapshots of healthy sectors and uses a polymorphic analyzer to detect stealth viruses. New signature files are freely downloadable for a year after purchase, and a bundled version of Quarterdeck's *Update-It* utility runs in the background to automatically check for new updates and install them.



Scanning using saved set "Default"

Now scanning file:
C:\WIN95\WABMIG.EXE

Scan statistics
Files scanned: 621
Size scanned: 131M
Elapsed time: 00:00:30
Viruses found: 0
Not removed: 0

Memory OK.
C: Boot sector is clean.

ViruSweep *achieves its lightning-fast scans in part by using saved sets to scan only changed files.*

Price $40
Developer n-Space Inc.
Publisher Quarterdeck
Phone 800.354.3222
URL www.quarterdeck.com

boot verdict 5

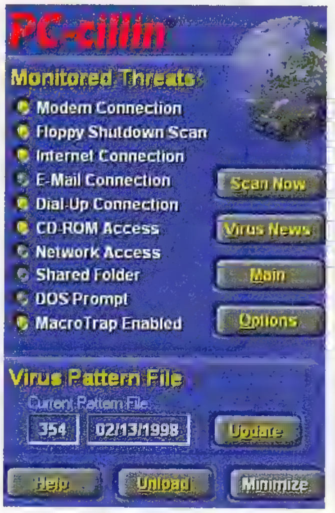
Touchstone **PC-cillin** 3.0

TRY IT ON THE DISC

With innovative features such as an integrated web browser, a built-in e-mail client for sending infected files, and a versatile background monitor that autoconfigures to its environment, *PC-cillin* offers a unique approach to virus protection. If it was equipped with a more powerful scanning engine, *PC-cillin* would be a world-class antivirus package; unfortunately it's strengths lie outside of powerful virus cleanup.

Embedded into *PC-cillin*'s main program (through an ActiveX control) is the Internet Virus Lab, a mini web browser giving you instant access to the latest info and downloads from Touchstone and Trend. *PC-cillin*'s background monitor turns monitoring features on and off depending on what you're doing. Fire up the modem and launch your web browser and SmartMonitor will kick in its dial-up and Internet components to block infected downloads. It also picks up on macro viruses with its patent-pending MacroTrap heuristic scanner.

PC-cillin missed 9 of our 40 randomly selected viruses and took 8 minutes and 39 seconds to complete a scan of a 2GB hard drive. After detection, the Cleaning Wizard automatically cleans all the files it's able to, and then leads you into the virus lab to check the freshness of your virus tables. You're then prompted to send out a "good neighbor" message to anyone who may have received the virus from you. Next you are presented with the option to mail your infected files to a *PC-cillin* technician that may or may not return a disinfected file to you. Regardless of whether you use the Wizard, you're eventually left with a list of uncleanable files that you must manually choose to either rename or delete.



Monitored Threats
- Modem Connection
- Floppy Shutdown Scan
- Internet Connection
- E-Mail Connection
- Dial-Up Connection
- CD-ROM Access
- Network Access
- Shared Folder
- DOS Prompt
- MacroTrap Enabled

Virus Pattern File
Current Pattern File
354 02/13/1998

PC-cillin'*s SmartMonitor automatically adjusts its protection.*

Price $40
Developers Touchstone and Trend Micro
Publisher Touchstone
Phone 714.969.7746
URL www.touchstone-sc.com

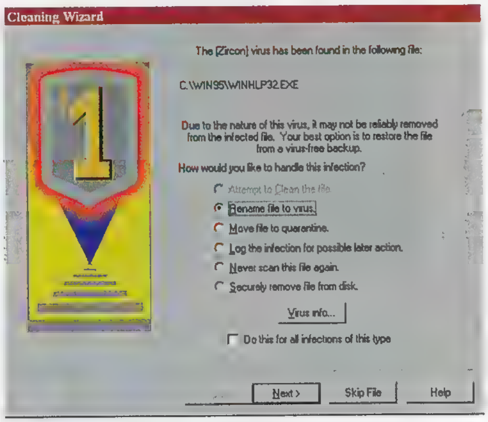
boot verdict 6

Inoculan AntiVirus 5.0

TRY IT ON THE DISC

Inoculan AntiVirus is the most thorough virus scanner in this roundup. Its clean, straightforward interface leaves no doubts as to what's happening during each step of the scanning process, and new-virus signature files are free for a year after purchase. Unfortunately, *Inoculan*'s intolerably slow scan times and tendency to falsely identify clean files as infected tarnish the program's overall effectiveness.

Inoculan uses several detection technologies to fight the good fight. A tenacious signature-scanning engine and disk-sector integrity checker round up all the usual suspects, and a polymorphic analyzer picks up on viruses that can disguise their signatures by executing them in protected memory. *Inoculan* also implements a heuristic scanner, but this is limited to macro virus detection.


Cleaning Wizard

The [Zircon] virus has been found in the following file:

C:\WIN95\WINHLP32.EXE

Due to the nature of this virus, it may not be reliably removed from the infected file. Your best option is to restore the file from a virus-free backup.

How would you like to handle this infection?

○ Attempt to Clean the file.
● Rename file to virus.
○ Move file to quarantine.
○ Log the infection for possible later action.
○ Never scan this file again.
○ Securely remove file from disk.

☐ Do this for all infections of this type

If **Inoculan** *has it in for a file there isn't much you can do to tell it that it's not infected.*

Inoculan missed only one of our 40 randomly sampled viruses. Of course the scanner had plenty of time to pore over our 2GB hard drive during the 42 minutes it took to complete a thorough scan. Switching to a quick scan yielded a slightly more bearable 16 minutes and 39 seconds, but was still far off *Norton*'s 2-minute and *ViruSweep*'s 51-second scan times. Upon detection of offending viruses, the program sounds an annoying siren as it safely packs the infected file into a quarantine folder and prompts for course of action. If possible, the default action is to clean the virus, if not you can rename, move, delete, or merely log it for future action.

The most annoying aspect of *Inoculan AntiVirus* is the scanner's tendency to cry wolf. In our test scans, two DOS utilities and a Win95 help file (WINHLP32.EXE) were continually identified as infected even when the files were restored from their known clean originals. In the case of the Win95 help file, *Inoculan* wouldn't allow any use of the Win95 help system after identifying the file as infected. With overzealous protection like this, who needs real viruses?

Price $40
Company Computer Associates
Phone 800.243.9462
URL www.cheyenne.com

boot verdict 6

America's Least Wanted

The viruses we used in our test scans consisted of a number of notorious troublemakers such as the Antiexe, Monkey, and AntiCMOS viruses, a number of Word Prank macro viruses, and a random assortment of oddities culled from various seedy web sites. While all the antivirus products picked out all the Word prank macros and notorious viruses in our test scans, they all failed to detect one oddball—the FoolTBC virus. In fact, none of the products' online virus encyclopedias had any record of this virus, which when executed displays the message "TB-Clean stinks!!!" The only information we have on the virus was that the infected file was dated Feb. 17, 1995. If you see this virus or know anything of its current whereabouts, please contact the proper authorities.

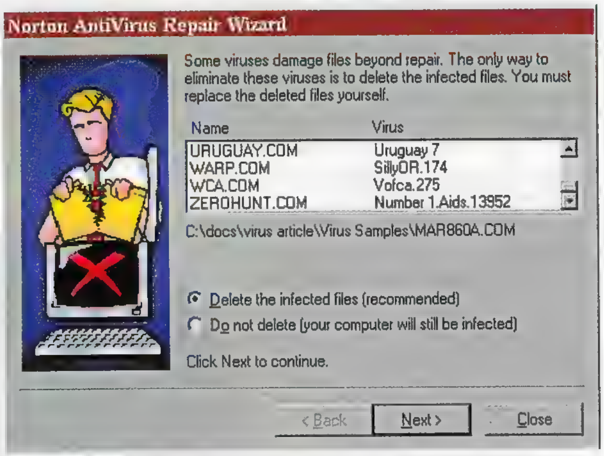
Norton **AntiVirus** 4.0

TRY IT ON THE DISC

Norton AntiVirus's (*NAV*'s) greatest strength is its extensive configurability. It has everything, from the scanner to unknown virus inoculation to a customizable background monitor that offers as much (or as little) protection as you need. Scans can be limited to Word documents, in the event of a pesky macro-virus outbreak, for instance, or the background monitor can be customized to deal automatically with different virus infections in a variety of ways; it can even initiate a Win95 shutdown.

NAV's advanced scanning technologies come in the form of Striker, its polymorphic scanning engine, and Bloodhound, its heuristic scanner. Striker executes suspected viruses in protected memory and eliminates any bad seeds, and Bloodhound searches for unknown viruses by monitoring file structures and attributes. You can easily adjust the aggressiveness of Bloodhound's search.

In our test scans, *NAV* missed four out of 40 randomly selected viruses. Its 2GB hard drive shakedown took 1 minute 53 seconds. After detection, the Repair Wizard handles the cleaning process automatically, but an option is available to clean, delete, or rename the infected file(s) manually. An option to automatically make backups of infected files before cleaning is also available.


Norton AntiVirus Repair Wizard

Some viruses damage files beyond repair. The only way to eliminate these viruses is to delete the infected files. You must replace the deleted files yourself.

Name	Virus
URUGUAY.COM	Uruguay 7
WARP.COM	SillyOR.174
WCA.COM	Vofca.275
ZEROHUNT.COM	Number 1.Aids.13952

C:\docs\virus article\Virus Samples\MAR860A.COM

● Delete the infected files (recommended)
○ Do not delete (your computer will still be infected)

Click Next to continue.

NAV *'s Repair Wizard keeps you informed every step of the way, giving you the option to delete uncleanable files or even leave them alone.*

From installation to detection to virus removal, every screen presents logical choices. The attention to detail is obvious even in something as simple as the creation of rescue disks, which not only scan and replace damaged boot sectors but also load CD-ROM and ASPI drivers. It also comes in an NT version. *Norton AntiVirus* is a straightforward, no-nonsense virus detection and prevention package.

Price $50
Company Symantec
Phone 800.441.7234
URL www.symantec.com

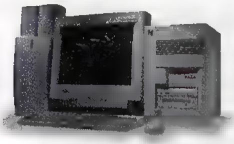
boot verdict 8

Speeds and Feeds

	Scan Time	Failure Rate
ViruSweep	0:51	30%
PC-cillin 3.0	8:39	22.5%
Inoculan AntiVirus 5.0	42:00	2.5%
Norton AntiVirus 4.0	1:53	10%

CompUSA American Pro

A proficient, patriotic PC



When CompUSA first announced plans to offer its own build-to-order PCs, we were skeptical.

Oh sure, CompUSA's American Pro is adorned with the standard accoutrements—a 333MHz Pentium II processor, 3D accelerator (courtesy of a 4MB-equipped Riva 128), oodles of SDRAM (64MB, upgradable to 384MB), and an integrated Zip drive. But if you were hoping for something a little more daring—perhaps a colorful case design or maybe a feature or two that thumbed its nose at the rest of the PC population—you won't find such innovation here. This American Pro is a "boy-next-door" type of PC—functional, capable, and very vanilla.

Despite the overabundance of ordinary, the American Pro still manages to perform up to snuff. All the bootMarks fell within the range of higher-profile PCs, and all the individual components, including the Maxtor 8.4GB hard drive, front-loading Pioneer CD-ROM, and the STB Velocity 128 AGP card, are regular visitors to the bootLab.

Still, there's something to be said for consistency, and if there's one adjective that best describes the American Pro, it's consistent. We ran into virtually no problems running any of our benchmarks, apps, or games. In fact, the only hiccup we encountered was a one-off "the system is dangerously low on resources" error message. Pretty encouraging stuff.

Not so encouraging was the inclusion of Microsoft's Active Desktop. Don't PC manufacturers realize just how annoying and how big a resource hog Active Desktop really is? Ugh. We also didn't much care for the garish CompUSA logo that came pre-installed as the desktop background. Thankfully, both these "features" can be remedied in a hurry.

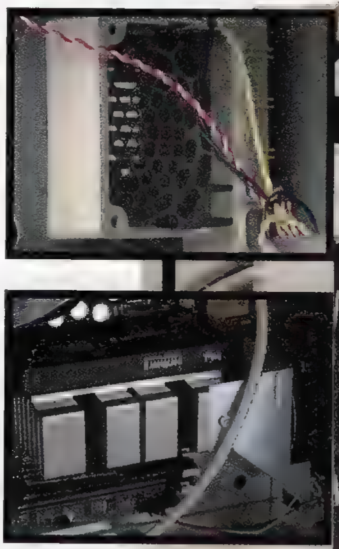
And the sorry-ass OPL3 SA sound chip has got to go. Hardware wavetable and PCI audio are the keys to winning our coveted Kick-Ass award.

With the roomy interior surprisingly clutter free, expansion possibilities abound. But what's up with the inverted mid-tower case design? Most AT cases position the hard drive and power supply at the top, with the expansion cards resting near the bottom. With the American Pro, the entire thing—even including the light icon on the front—appeared to be flipped. It wasn't until after we checked the photo from CompUSA's web site that we were convinced a mistake wasn't made in production.

The American Pro includes a 17-inch monitor, but with a maximum resolution of only 1280x1024@60Hz, it isn't worth considering. Take our advice: don't buy it. The $355 you save can be put toward a quality 19-incher instead.

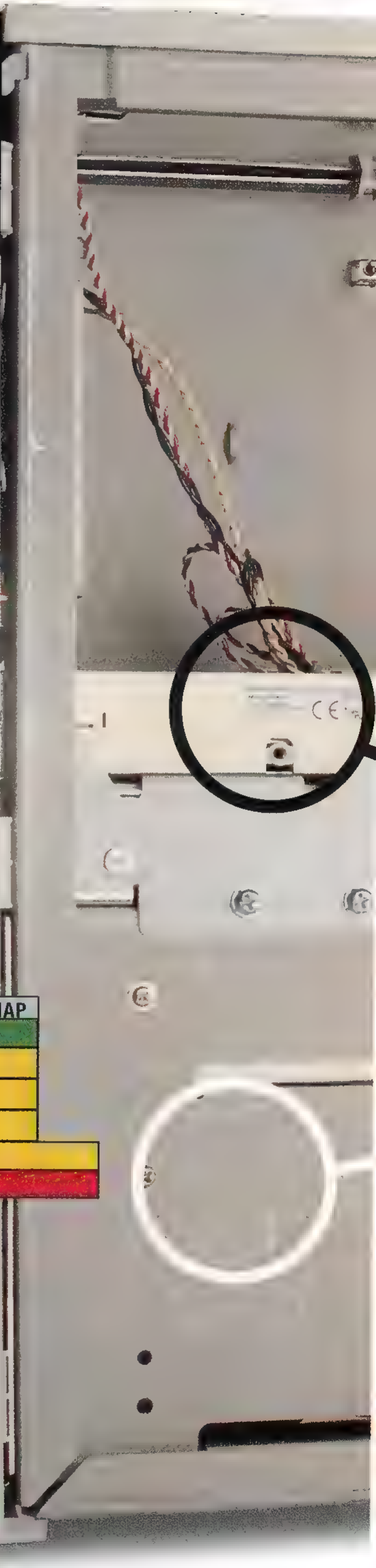
The American Pro is a good machine, but it could be made even better by lowering the price and buffing up some of the features. Similar configurations, including Gateway 2000's G6-333, can be had for a few hundred dollars less, and even include a DVD-ROM. Our advice? Shop around.

—*Bryan Del Rizzo*



THE ULTIMATE FANZINE

The air distribution system works despite the fact that the fan is mounted on the bottom. Last time we checked, heat rises. The heatsink on the processor is combined with a plastic airflow and fan. There's even space on the front of the case for some additional spin control.



under the hood

THE BRAINS

CPU	Intel Pentium II 333MHz
L2 Cache	512K Internal
RAM	64MB SDRAM (384MB max)
Motherboard	Intel 440LX AGP

THE BRAWN

Video	STB Velocity 128 AGP with 4MB SGRAM
Hard Drive	8.4GB Maxtor EIDE
CD-ROM	Pioneer DR504 32x
Expansion	Three PCI, two ISA, one shared, one AGP
Fax/Modem	56.6Kbps K56-compatible
I/O Ports	Two serial, one parallel, two USB, gameport, two PS/2

THE BEAUTY

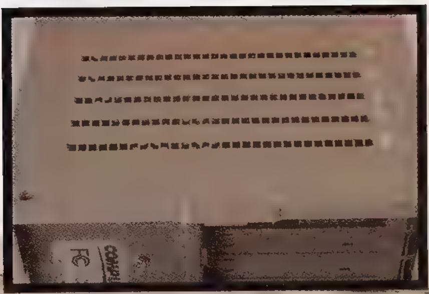
Case	Three 5.25-inch bays, one 3.5-inch bay
Display	Maxtech CPC7861 17-inch, .28mm dot pitch
Sound	Yamaha OPL3-SA FM synth/software wavetable
Speakers	Altec Lansing ACS45 with two 3-watt satellites and one 20-watt subwoofer
Other	Iomega 100MB Zip drive

THE BUNDLE Microsoft Office 97 Small Business Edition

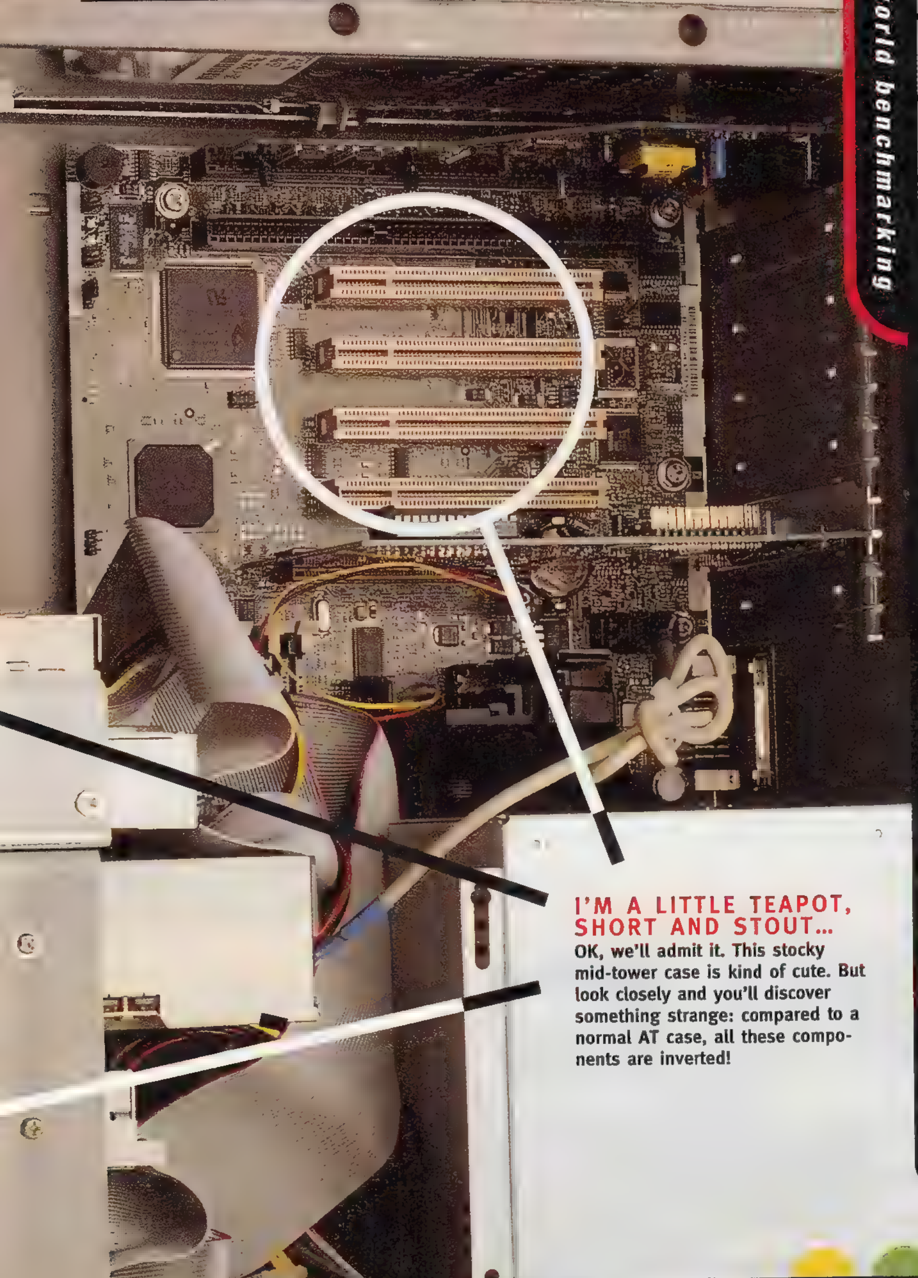
boot	down
0:56	:02

EXPANSION MAP

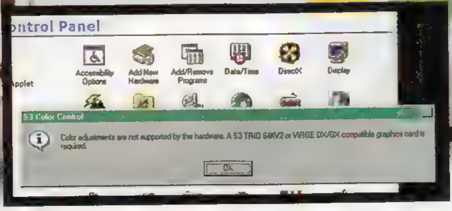
AGP	2D/3D Video
PCI	Free
PCI	Free
PCI	Free
ISA/PCI	Free
ISA	Modem



BLOW HOLES
The top of the case is vented, presumably to compensate for the upside-down design, which locates the fan on the bottom.



I'M A LITTLE TEAPOT, SHORT AND STOUT...
OK, we'll admit it. This stocky mid-tower case is kind of cute. But look closely and you'll discover something strange: compared to a normal AT case, all these components are inverted!

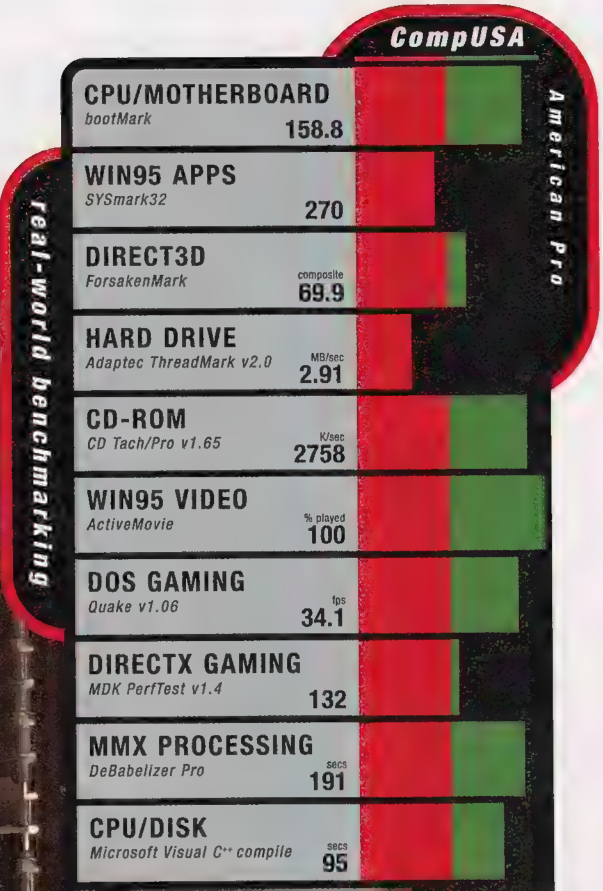


Color adjustments are not supported by this hardware. A S3 TRIO 64V2 or ViRGE DX/GX compatible graphics card is required.

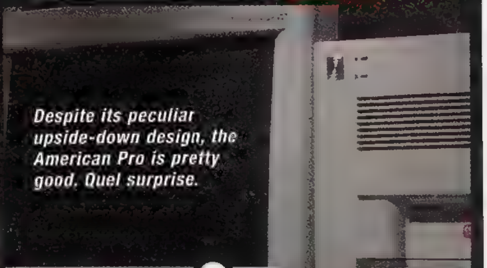
THE JOSHUA THREE
Hmmm... why is this S3 applet installed? There's no ViRGE card in this machine!

CompUSA
American Pro

real-world benchmarking



Test	Benchmark	Unit	Score
CPU/MOTHERBOARD	bootMark		158.8
WIN95 APPS	SYSmark32		270
DIRECT3D	ForsakenMark	composite	69.9
HARD DRIVE	Adaptec ThreadMark v2.0	MB/sec	2.91
CD-ROM	CD Tach/Pro v1.65	K/sec	2758
WIN95 VIDEO	ActiveMovie	% played	100
DOS GAMING	Quake v1.06	fps	34.1
DIRECTX GAMING	MDK PerfTest v1.4		132
MMX PROCESSING	DeBabelizer Pro	secs	191
CPU/DISK	Microsoft Visual C++ compile	secs	95



Despite its peculiar upside-down design, the American Pro is pretty good. Quel surprise.

+	−
Pentium II 333MHz	Inverted case design
Expansive case	Run-of-the-mill monitor
Bonafide performer	Lackluster audio subsystem
Tubthumping speaker system	Active Desktop
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boot verdict 7

A complete breakdown of benchmark results is available on the *bootnet*. Point your browser to www.bootnet.com

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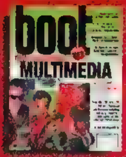

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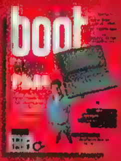

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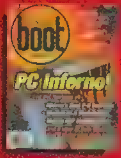

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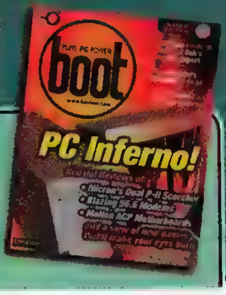

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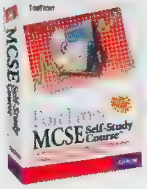

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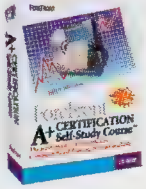

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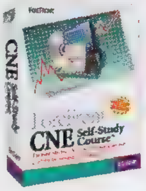

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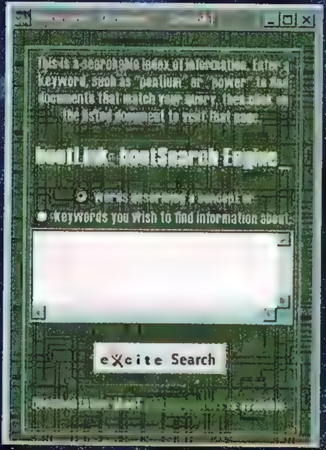
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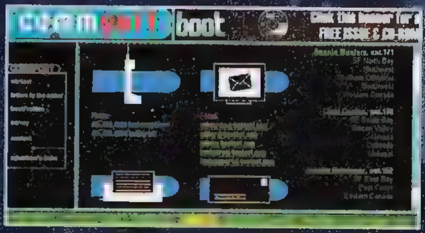
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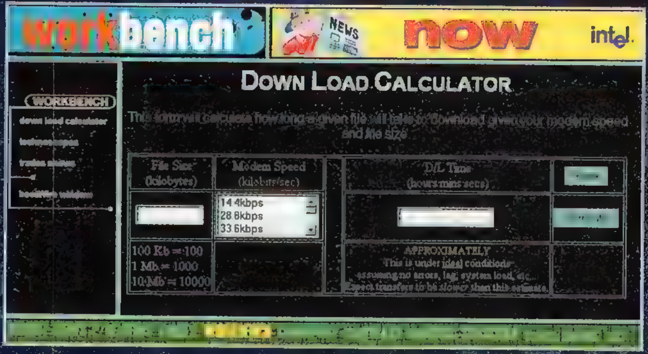
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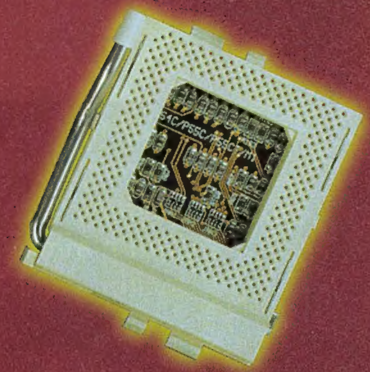

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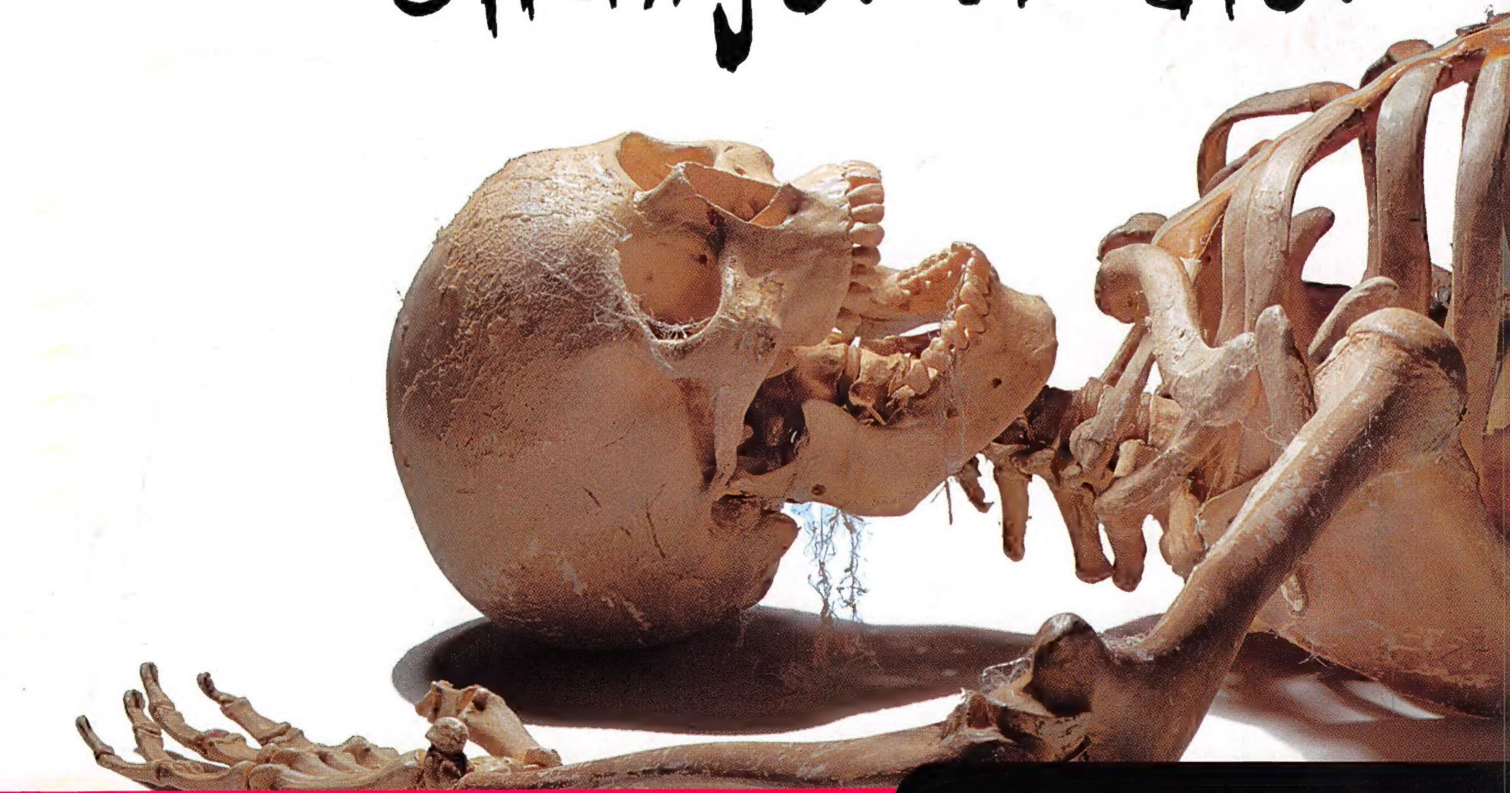

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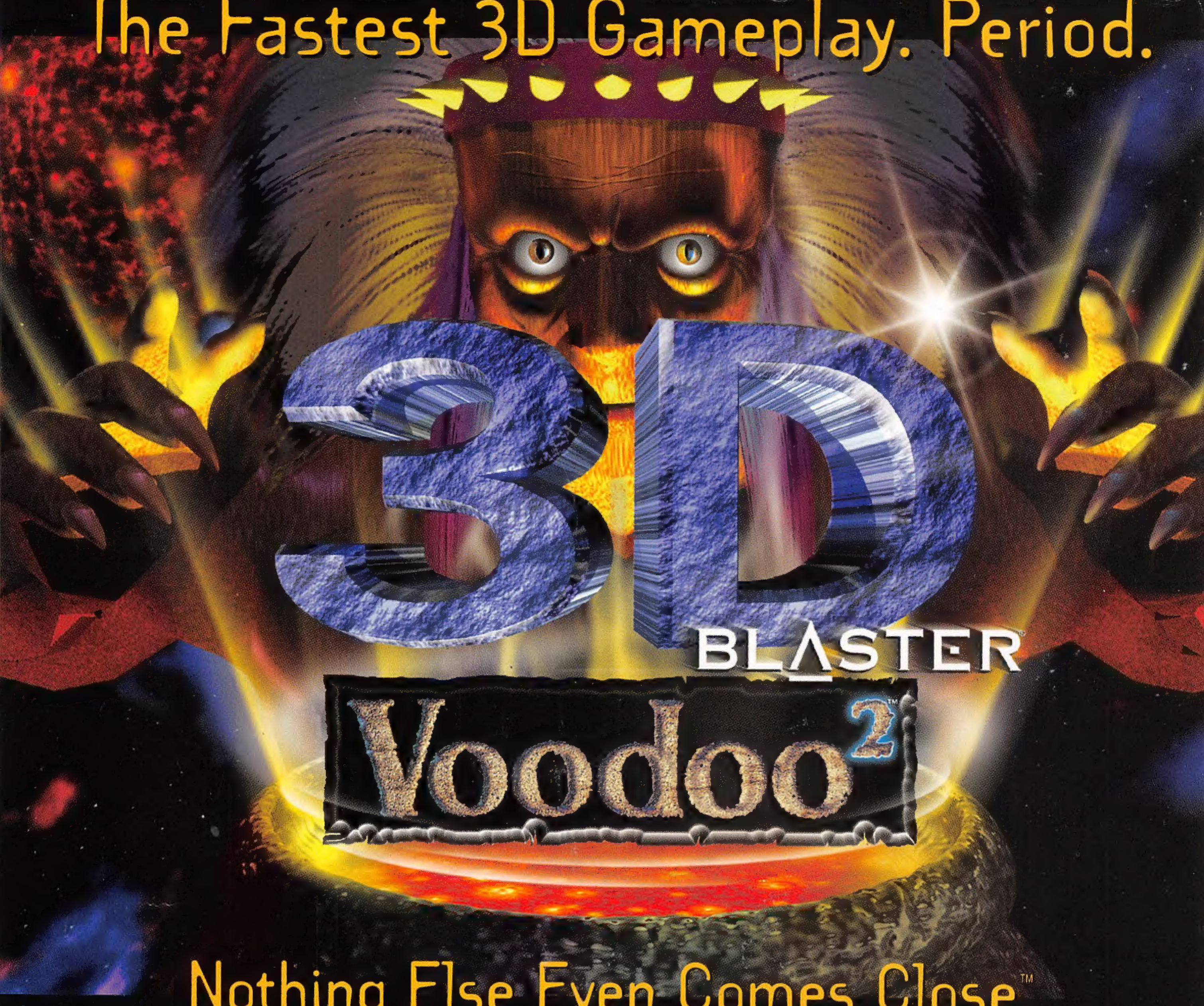

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